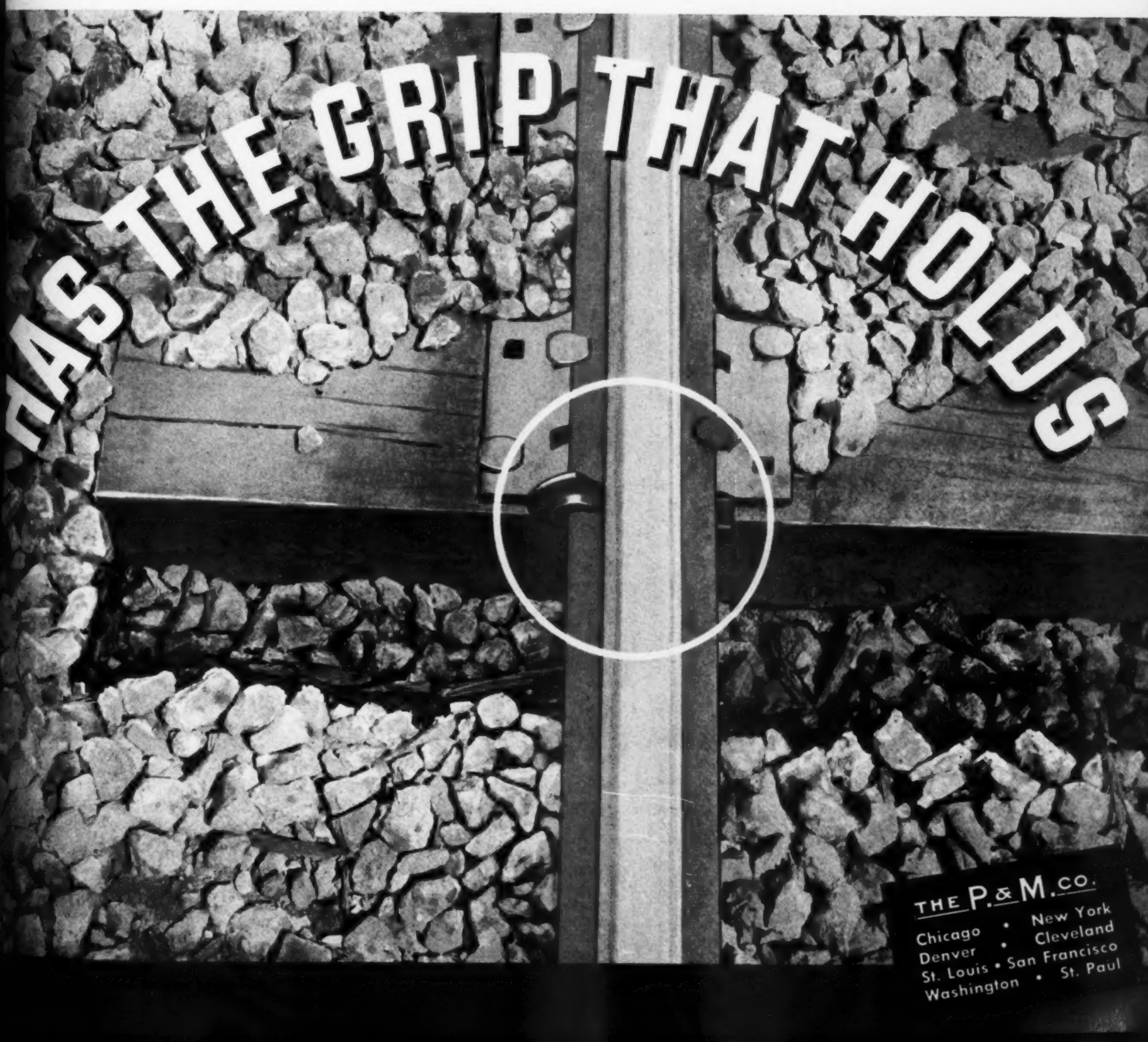
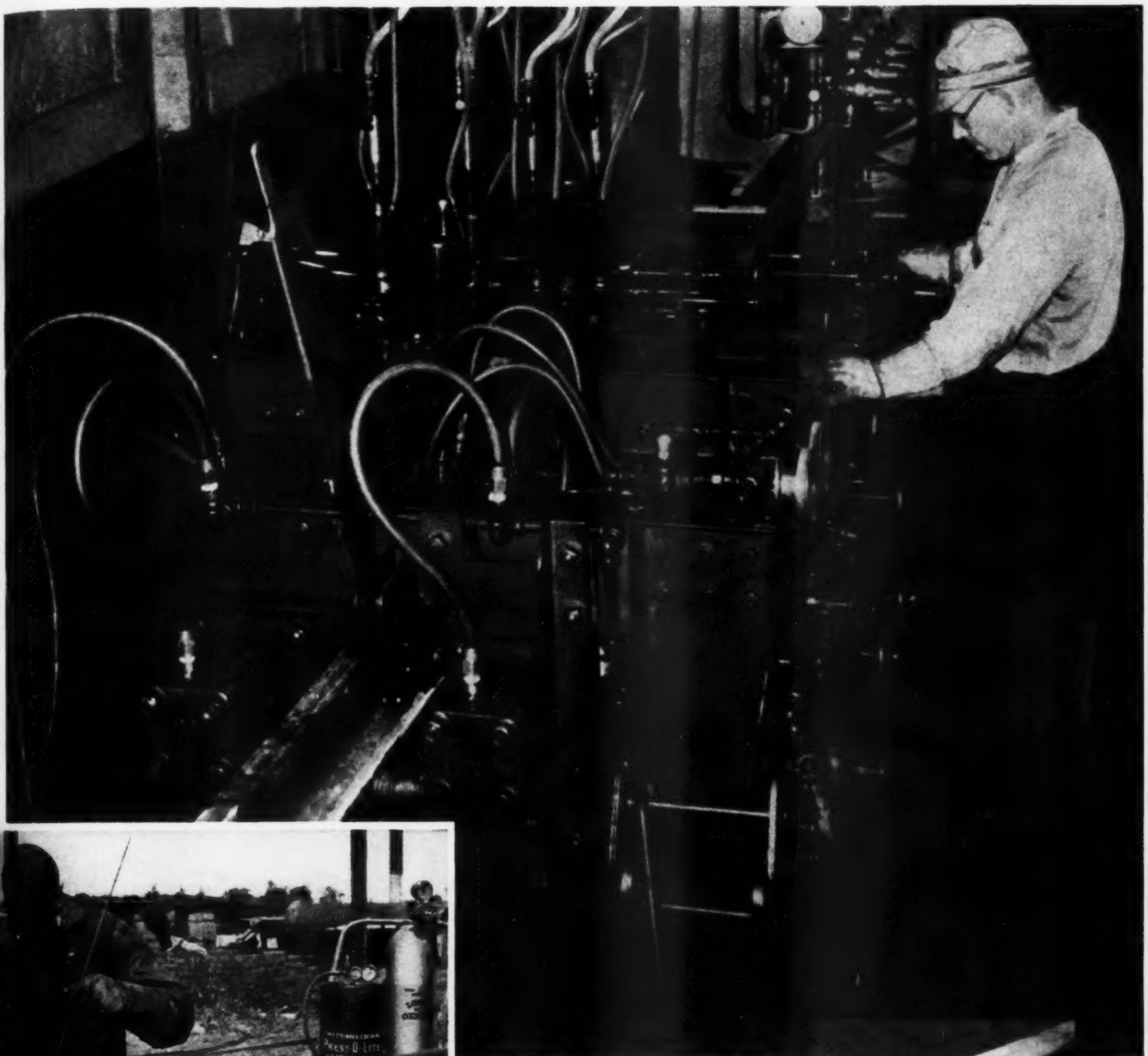
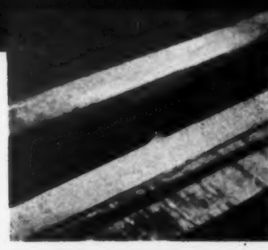
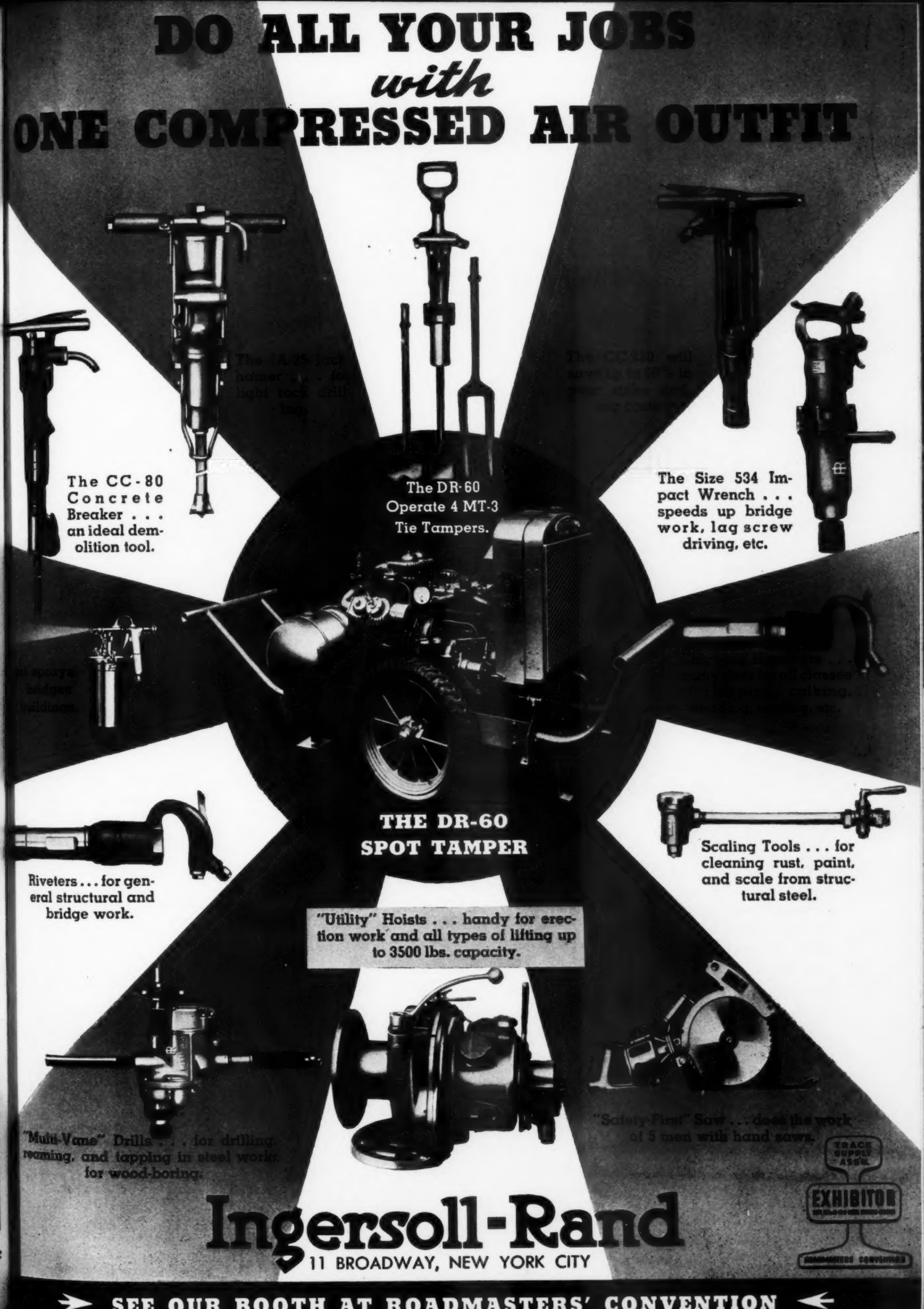
# The Improved Fair Rail Anchor



Published monthly by Simmons-Boardman Publishing Corporation, 105 W. Adams St., Chicago, Ill. Subscription price: United States and Possessions, and Canada, $2.00; Foreign, $3.00. Single copies 35 cents. Entered as second-class matter January 20, 1933, at the post office at Chicago, Ill., under the act of March 3, 1879, with additional entry at Mount Morris, Ill., postoffice. Address communications to 105 W. Adams St., Chicago, Ill.







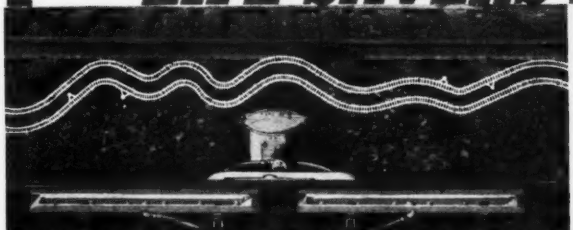
DO ALL YOUR JOBS
with
ONE COMPRESSED AIR OUTFIT
The CC-80 Concrete Breaker . . . an ideal demolition tool.
The DR-60 Operate 4 MT-3 Tie Tampers.
The Size 534 Impact Wrench . . . speeds up bridge work, lag screw driving, etc.
THE DR-60 SPOT TAMPER
Riveters . . . for general structural and bridge work.
Scaling Tools . . . for cleaning rust, paint, and scale from structural steel.
"Utility" Hoists . . . handy for erection work and all types of lifting up to 3500 lbs. capacity.
"Multi-Vane" Drills . . . for drilling, reaming, and tapping in steel work; for wood-boring.
"Safety First" Saw . . . does the work of 5 men with hand saws.
TRACK SUPPLY ASS'N.
EXHIBITOR
Ingersoll-Rand
11 BROADWAY, NEW YORK CITY
SEE OUR BOOTH AT ROADMASTERS' CONVENTION


# "LIFE—SAVERS"

## FOR THE TRACK DEPARTMENT

**Today's greatly increased traffic due to defense shipments and improved general business, puts extra demands on rails, with replacements hard to get. Save rail life at every possible point. Here are protection devices to help you:**

## • *LIFE SAVERS for CURVE RAILS . .*



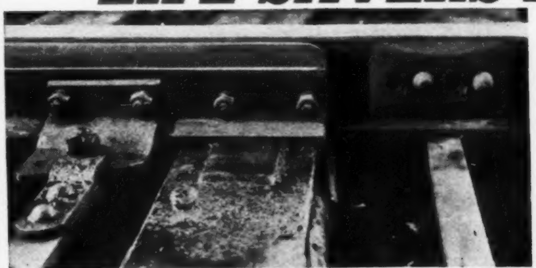
Each Meco Lubricator Protects a Number of Curves

### MECO CURVE LUBRICATORS

**Meco Curve Lubricators make curve rails last as long as tangent rails; reduce friction, make curves safer for today's higher speeds. Meco "Long Range" Lubrication reaches to the far ends of a long curve territory.**

***Over 4,200 in use***

## • *LIFE SAVERS for SWITCH RAILS*

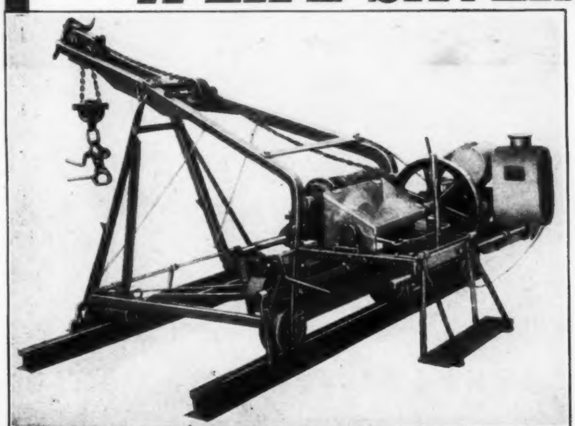


### MACK REVERSIBLE SWITCH POINT PROTECTORS

**Give switch rails "nine lives"; make them last 8 to 10 times as long, because of reversible feature. Get this extra protection at the "weak point."**

***Over 164,000 Mack Switch Point Protectors have been applied on more than 100 railroads.***

## • *A LIFE SAVER for the TRACK FORCES*



### POWER RAIL LAYER

**Reduce demands on overworked track forces. The Power Rail Layer is operated by just a few men; no expensive power-propulsion equipment; a "life-saver" for the track department under present conditions.**

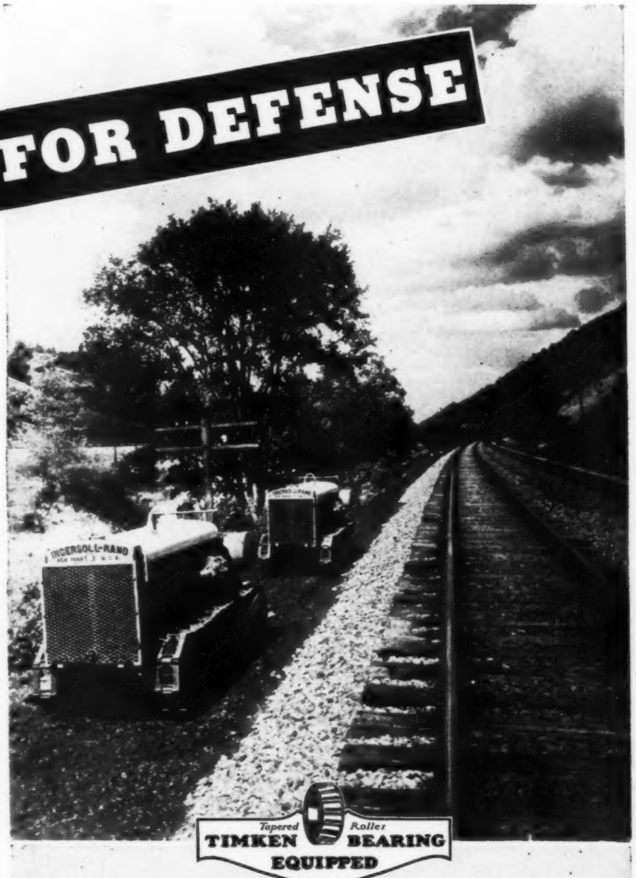
***Investigate these "Life Savers," to make a good showing in the face of today's difficulties.***

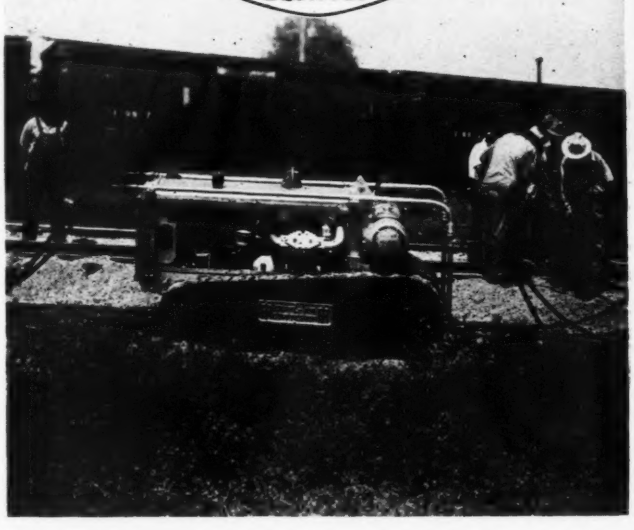
*Exhibiting at Booths 92 and 107—T.E.A.*

# MAINTENANCE EQUIPMENT COMPANY

RAILWAY EXCHANGE BUILDING CHICAGO, ILLINOIS


# RIGHT OF WAY FOR DEFENSE



Defense transportation is putting a constantly-growing strain on the railroads, hence the increasing burden of track maintenance.

Ingersoll-Rand Crawl-Air Compressor as shown in the photograph is used to supply power for pneumatic tie tampers and other time-saving track tools.

The advantages of this self-propelled compressor outfit for railroad track work are obvious. It can go anywhere. It is independent of the track. It can operate constantly without interruption.

Timken Tapered Roller Bearings are applied to the main shaft of the Ingersoll-Rand Two-stage Air-cooled Compressor to assure the full benefits of anti-frictionization at this vital point. Ingersoll-Rand has used Timken Bearings for years; has proved that they meet every requirement with utmost efficiency and dependability.

**THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO**

**TIMKEN**
TRADE-MARK REG. U. S. PAT. OFF.
*TAPERED ROLLER BEARINGS*

Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; Timken Alloy Steels and Carbon and Alloy Seamless Tubing.

# TELEWELD *Saves*

PATENTED

# STEEL FOR YOU AND DEFENSE

Save STEEL for National Defense! Cut rail renewals and get more service from your present rails! How? By taking advantage of Teleweld's specially trained men, specially developed machines and processes that restore damaged and weakened rails to new-rail specifications.

Teleweld machines and processes are the result of over 20 years experience and the Teleweld organization of skilled engineers, welders and workmen has been thoroughly trained to handle track reclamation work economically, efficiently and speedily.

1. Reconditioned Rail Joint by Teleweld Process

2. Manganese Frog Before & After Teleweld Reclamation

3. Heat Input Operation: Teleweld Rail-End Hardening

### RAIL ENDS REBUILT BY TELEWELD PROCESS

**1** Special Teleweld process of arc welding, exclusive preheating and differential tempering restores chipped and worn rail ends to original contour and wearing qualities. Entire process takes very little time and is done right on the track with special portable equipment.

### RESTORING SWITCH POINTS, FROGS, CROSSINGS

**2** Worn switch points, crossings, frogs of open-hearth and manganese steel are completely rebuilt by Teleweld Process of Electric Arc Welding which concentrates heat at contact point only, eliminating possible damage to steel. Only the most proficient welders used. Portable power plant and special welding equipment handle wide range of this work with speed and economy.

### RAIL END HARDENING BY TELEWELD PROCESS

**3** A pre-determined hardness is automatically and scientifically imparted to rail ends without causing brittleness. Rail ends so hardened effectively withstand the battering of heavy wheel loads. Process takes less than 100 seconds—done at mill or on the track. Standard practice on many roads.

## TELEWELD, INC.

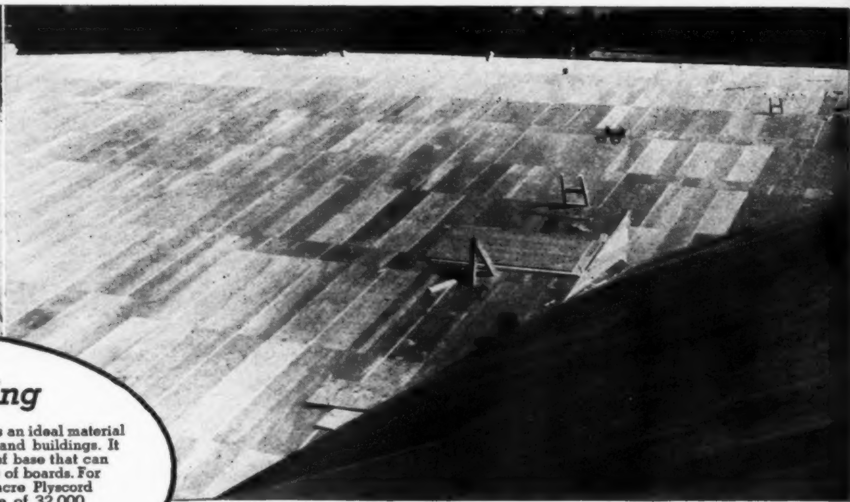
Railway Exchange Bldg., Chicago

Branches In Principal Cities


DON'T LET
SLOW DELIVERIES ON
Replacement Parts
TIE UP YOUR POWER

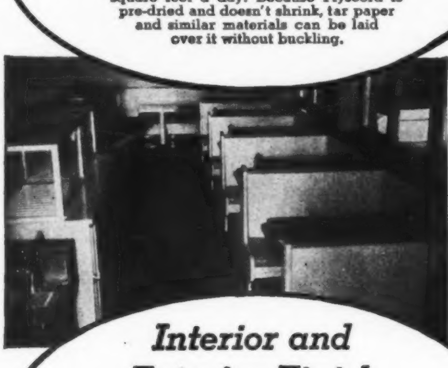
# *You build better and save time when you use Douglas Fir Plywood!*

## There is a grade or type for every construction purpose!



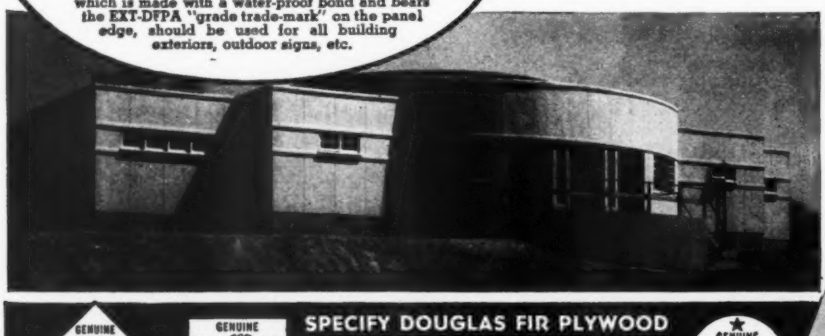
### *Roof Decking*

Plyscord-grade Douglas Fir Plywood is an ideal material for roof decks on both freight cars and buildings. It forms a rigid, durable, air-tight roof base that can be applied in half the time or less of boards. For instance, 9 men laid the 5½ acre Plyscord industrial roof deck at the rate of 32,000 square feet a day. Because Plyscord is pre-dried and doesn't shrink, tar paper and similar materials can be laid over it without buckling.



### *Interior and Exterior Finish*

Douglas Fir Plywood builds interiors and exteriors that can stand wear and tear, dirt, soot and smoke and weather conditions of all kinds. Plywall and Plypanel are the 2 grades used most frequently for interior walls, ceilings, cabinets, counters and fixtures. The Exterior type, which is made with a water-proof bond and bears the EXT-DFPA "grade trade-mark" on the panel edge, should be used for all building exteriors, outdoor signs, etc.



If you are planning new office, shop or station buildings, new freight or passenger cars, consider how Douglas Fir Plywood can help you. This "modern miracle in wood" has many structural advantages: large size, amazing strength, light weight and split-proofness. It makes walls, floors and roofs more rigid and, as a result, more resistant to high winds and earthquakes. It builds interiors that are crack-and kick-proof. It forms flawless concrete. It also serves in trusses, built-up girders and arches and for other engineering purposes.

The big panels minimize handling, cutting, fitting and nailing. They can be applied with less work and in less time than traditional materials. A 4′ x 8′ panel actually covers 32 square feet without waste, giving full value for your money.

There are 2 types of Douglas Fir Plywood: Moisture-Resistant for indoor uses and Exterior for permanent outdoor uses. Each type is manufactured in a variety of grades in strict accordance with U. S. Commercial Standard CS45-40. Every panel bears a distinctive "grade trade-mark" to facilitate specification and identification.

If you would like to know more definitely how Douglas Fir Plywood can serve you, write for free literature or technical assistance. Douglas Fir Plywood Association, Tacoma, Wn.

DOUGLAS FIR PLYWOOD
Real Lumber
MADE LARGER, LIGHTER
SPLIT-PROOF
STRONGER

GENUINE DOUGLAS FIR PLYFORM Concrete Form Panel D.F.P.A. INSPECTED

GENUINE PLYWALL Douglas Fir Plywood WALLBOARD D.F.P.A. INSPECTED

SPECIFY DOUGLAS FIR PLYWOOD BY THESE "GRADE TRADE-MARKS"

PLYPANEL D.F.P.A.

EXT.-D.F.P.A.

GENUINE PLYSCORD SHEATHING D.F.P.A.


This drill can operate either from the inside or the outside of the track, and in close quarters at switches and guard rails.

When laying rail, or when making track changes at terminals and yards, the Nordberg Rail Drill will greatly cut the time and cost of drilling holes as compared with equipment formerly used for this purpose. Of simple design, it can readily be set up and operated with the class of labor regularly used for track work. Since but few adjustments of the drill are required and these quickly made, no time is lost in getting the machine in operation. When moving to a new location, this drill is not removed from the rail but raised on its flanged rollers and pushed along the rail—an easy one man job. The flat bit is automatically and positively gripped by a simple chuck which requires no tools for tightening. Wherever holes must be drilled in rail, there is need for this time and money saving drill.

**LET THESE NORDBERG TOOLS HELP ON YOUR MAINTENANCE JOBS**

| | |
|---|---|
| Rail Drill | Grinders |
| Adzing Machine | Spike Puller |
| Power Jack | Track Wrench |
| Track Shifter | |

# NORDBERG MFG. CO. MILWAUKEE WISCONSIN

**Export Representative—WONHAM Inc.—44 Whitehall St., New York**

# 10 Years Service WITHOUT Maintenance Expense

MOSS READY-MADE SECTIONAL HIGHWAY CROSSINGS

*Today, this Moss Crossing, located in Chicago, is just as smooth and just as firmly in place as that day in 1931 when it was first installed.*

## *Check These 10 Outstanding Features*

1 ***Tested and approved*** by railway officers after carrying some of the heaviest and densest truck-traffic in the country for 10 years.

2 ***Low first cost*** is attained by pre-fabrication in modern Moss mills, and efficient creosoting at up-to-date Moss treating plants.

3 ***Longer service-life*** is assured by the use of Black Gum, carefully seasoned, pre-fabricated and thoroughly creosoted, all under expert supervision.

4 ***Lower maintenance cost*** is no idle slogan. Actual service records show 10 years service without maintenance expense and crossings good for years to come.

5 ***Shipped ready to install,*** no adzing, no sawing, no fitting. Moss Crossings are built to individual plans, ready for quick assembly.

6 ***Easy to install,*** no special tools or equipment necessary. A small track gang, with regular tools, can do the job.

7 ***No humps, no bumps,*** no broken surfaces, no continual patching. After 10 years' service, Moss Crossings are as smooth as the day they were laid.

8 ***Built for heavy duty,*** of thick Black Gum timbers, Moss Crossings are as rugged as the track.

9 ***Easy to remove,*** if track work is ever necessary, the light-weight sections can be reinstalled without delay and without detouring highway traffic.

10 ***Full salvage value*** in the event of crossing elimination. Quickly removed, ready for use, without waste, at other locations.

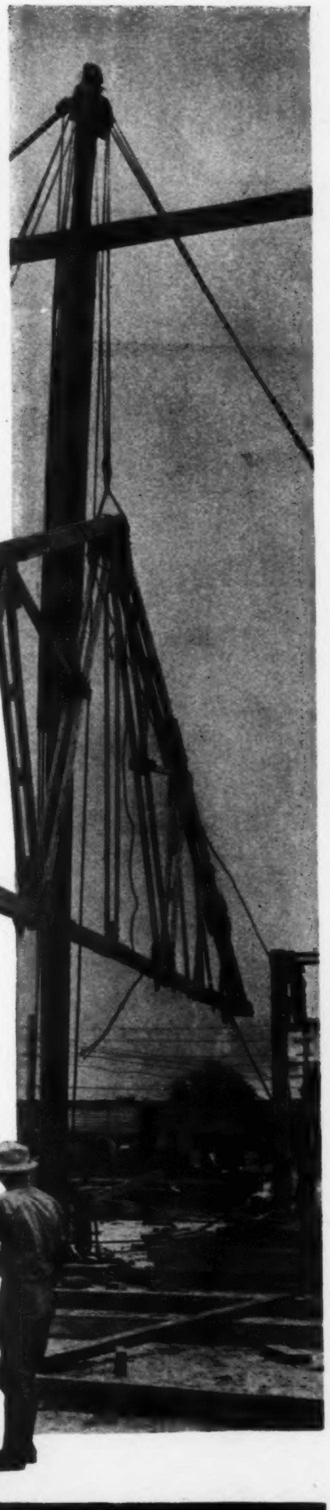
# T. J. MOSS TIE COMPANY

**SECURITY BUILDING, ST. LOUIS, MISSOURI**

The Stamp of Character MTCo

FOUNDED 1879

# Built of Timber in 34 Days!



# TECO
## CONSTRUCTION
## Hurries-Up Big Warehouse

Speedy construction of Warehouse No. 1 of the Tampa Union Terminals was an urgent, emergency demand upon the contractors.

The entire 320'x100' building was completed and accepted by the company in just 34 working days!

Prefabrication and the TECO System of timber construction made this record possible. The roof trusses, 100 feet in span, were jointed by TECO Connectors.

The TECO System has given engineers an opportunity to speed construction and cut costs on major building projects wherever time and cost are vital elements.

Write for Literature

**TIMBER ENGINEERING COMPANY, INC.**

DEPT. F-10 1337 CONNECTICUT AVENUE
WASHINGTON, D. C.

# Before you patch your roofs for winter . . . .

**read this**

Have you ever figured out how much it costs you to repair your leaking roofs . . . labor, materials, damage to contents of the buildings? Many companies are surprised when they finally add up the total. Many company executives, who seldom or never see the oft-repeated trips of the repair crews, do not realize how lusty a total this is.

Do you realize that a new roof of Koppers Coal Tar Pitch can be laid over your old roof . . . and that it will be good for 20, or 30, or even 40 years of service? The cost of the new roof, divided by 20 or 30 or 40, will give you a lower year-by-year cost than the unending bills for repairs.


When you fix up your roofs for winter this time fix them up for good. Let us send you the Koppers Roofing Specification book which tells why it takes Coal Tar Pitch and Tar-saturated Felt to withstand the conditions that attack roofs . . . and how Koppers Pitch and Felt perform under those conditions.

**KOPPERS**
**COAL TAR PITCH ROOFING**
**AND WATERPROOFING**

**KOPPERS COMPANY**

**TAR AND CHEMICAL DIVISION**
**PITTSBURGH, PA.**

*Fill out and mail*

Postage Will be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

**BUSINESS REPLY CARD**

FIRST CLASS PERMIT NO. 1046, SEC. 510 P. L. & R., PITTSBURGH, PA.

KOPPERS COMPANY

1265 Koppers Building (19)

Pittsburgh, Pa.

No. 154 of a series

# Railway Engineering and Maintenance

SIMMONS-BOARDMAN PUBLISHING CORPORATION

105 WEST ADAMS ST.
CHICAGO, ILL.

October 1, 1941

**Subject:** Renewal Percentage

Dear Reader:

As the editor of Railway Engineering and Maintenance, I am constantly concerned about the degree to which the information that we bring to you from month to month meets your needs,for we know that only as it does so will we continue to merit your interest, especially in these busy days when there are so many demands on your time. We have one index, of course, in the number and nature of the letters that we receive from so many of you. We are deeply appreciative of these, for we find them very helpful. We realize, however, that they come from a relatively small proportion of you and we often wonder what kind of a job the rest of you think that we are doing.

There is one index that gives us a fairly accurate measure of your approval. This is the semi-annual audit of our circulation, made on forms prescribed by and subject to check by the Audit Bureau of Circulations, an independent agency set up to determine the nature and volume of the circulation of publications available to advertisers. One figure in this audit is of special interest to me as the editor of your magazine. That is the percentage of the subscriptions that are renewed. In the report for the period ending June 30, 1941, which was made public only a few days ago, this figure for Railway Engineering and Maintenance was shown to be 78.28 per cent.

We are proud of this figure, especially in these days of such frequent changes in position, heavy retirements and large turnovers in organization. Its measure is shown best by comparison with the records made by other publications. Speaking of renewal percentages some time ago, the then-president of the Associated Business Papers, Inc., said that "any business paper which continuously comes through with a renewal ratio of 55 to 60 per cent or better is doing real work. This registers reader acceptance and reader prestige." Still another basis is offered by comparison of our renewal percentage with those of such outstanding magazines as Time, Fortune and Life, whose renewal percentages are given in current A.B.C. reports as 62.75, 67.21 and 76.66 per cent, respectively.

We are proud of our percentage because it provides a measure of the favor with which you regard our work. It makes us feel that we are succeeding in establishing and maintaining a bond of mutual interest with you in the furtherance of our common objective of raising the standards of maintenance of way practices to still higher levels of efficiency. It is our hope that this bond may become still closer in the years that are ahead.

Yours sincerely,

Elmer T. Howson

ETH:EW

Editor

MEMBERS: AUDIT BUREAU OF CIRCULATIONS AND ASSOCIATED BUSINESS PAPERS, INC.

# *Raco Power Track Machine*

**The Raco delivers an exactly uniform power to every nut.**

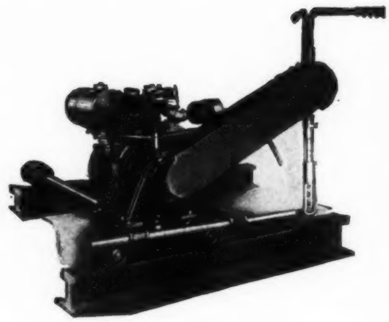
The new Raco Micro Cutout is easily applied to old machines with wrenches and screwdriver. **There are no obsolete Raco Machines.**

Light weight, fast, accurate, smooth operation, quality construction.

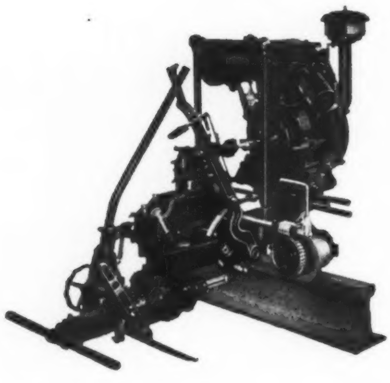
Purchased by 59 railroads.

# Raco Tie Boring Machine

Bores holes for **screw** spikes or **cut** spikes.
Bores ties in track more than **twice as fast** as any other accepted means.
Bores holes **absolutely vertical.**
Locates all holes **exactly in center** of tie plate punching.
Automatically **controls depth** of hole.
Chips are blown away as fast as made, leaving hole clear.
One-man operation.
Machine can be removed from track by one man.



# Everett Power M-W Machine



For fourteen years the Everett M-W has been the standard power rail drill on practically all railroads.

Its design and construction insure the utmost in facility of operation and in speed and accuracy of adjustment.

It has made such astonishing records for economy that **no road can afford to use any other means for drilling bolt holes.**

# RAILROAD ACCESSORIES CORPORATION

**Main Office**
**137 East 42nd Street**
**(Chrysler Building)**
**New York**

# Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

OCTOBER, 1941

**Editorials** - - - - - - - - - - - - - - - - - 675

Railways—Supervision—Labor Camps—Shortages

**C.N.R. Builds Turntable Circle Wall of Precast Concrete Sections** - 678

Describes how this road, at Montreal, Que., by this expedient, reduced interference with the heavy normal use of the existing table

**Modern Materials Feature This Small Station** - - - - - 681

Describes new small passenger depot on the Erie, which is noteworthy because of the extensive use made of modern building materials

**Flame Cleaning Removes Paint From Concrete Tunnel** - - - 683

This article tells how this method was used successfully on the Erie, without causing damage to the underlying surface of the concrete

**Deep-Well Turbine Replaces Air Lifts** - - - - - - - - 684

New well and automatically-controlled, motor-operated pump at engine-house on an eastern road, promises to result in material savings

**Roadmasters Hold Annual Convention** - - - - - - - - 685

Reports of Committees on:
Rail-End Wear—Causes and Correction
Off-Track Versus On-Track Roadway Machines
Present-Day Roadway Drainage—Requirements and Methods
Maintenance of Right-of-Way Fences—Organization and Methods
Gravel Ballast—Its Requirements and Preparation
Recent Developments in the Renewal of Ties

**Track Supply Association Exhibit** - - - - - - - - - 714

**What's the Answer?** - - - - - - - - - - - - - 716

Causes of Rail Creepage
Capacity of a Septic Tank
Constructing Wood Crossings
Inspecting Turntables
Length of Guard Rails
Inspecting Ballast-Deck Trestles
What Is the Maximum Lift?
What Kind of Pump?

**Products of Manufacturers** - - - - - - - - - - - 723

**News of the Month** - - - - - - - - - - - - - - 725



Published on the first day of each month by the

SIMMONS-BOARDMAN PUBLISHING CORPORATION

105 West Adams Street, Chicago

NEW YORK
30 Church Street

CLEVELAND
Terminal Tower

WASHINGTON, D.C.
1081 National Press Bldg.

SEATTLE
1038 Henry Bldg.

SAN FRANCISCO
550 Montgomery St.

LOS ANGELES
Union Bank Bldg.

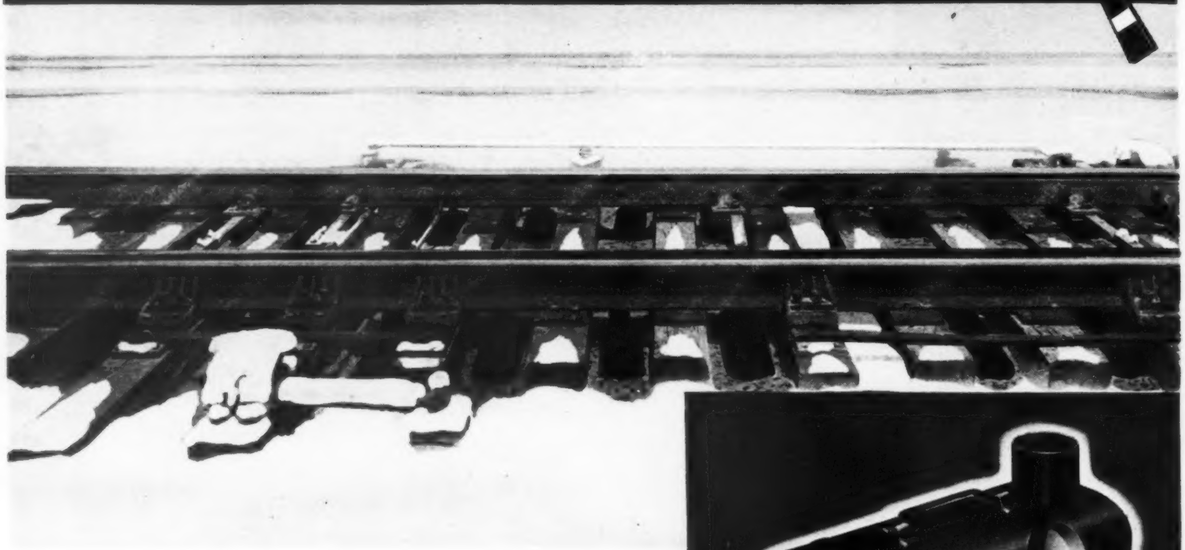


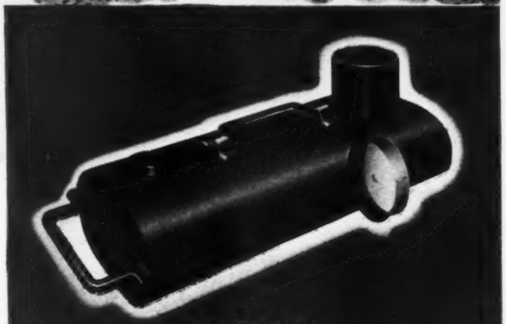
Subscription price in the United States and Possessions, and Canada, 1 year $2, 2 years $3; foreign countries, 1 year $3, 2 years $5. Single copies, 35 cents each. Address H. E. McCandless, Circulation Manager, 30 Church Street, New York, N.Y.

Member of the Associated Business Papers (A.B.P.) and of the Audit Bureau of Circulations (A.B.C.)

PRINTED IN U.S.A.

# Keep 'em rolling through ice and snow





PAT. PENDING

OUT OF the hue and cry of sales talks, there has been much confusion concerning the real advantages of various types of switch heaters. The new Hi-Ball Switch Heater has many definite improvements over existing types of heaters.

The Hi-Ball Switch Heater is dependable, economical, and safe. It is a great aid in reducing man hours required for track maintenance. It operates 30 to 40 hours on less than 1½ gallons of kerosene. We are justly proud of these accomplishments and so we say compare them all point by point. When the advantages of Hi-Ball are known, there will be no question of choice. Investigate now!—before winter sets in. Write for facts.

★ **More Economical Installation**

★ **Lower Maintenance**

★ **Lower Fuel Consumption**

★ **Eliminates Fire Hazards**

★ **Prevents Flame Blowouts**

★ **Controls Application of Heat**

★ **Self-Contained Unit**

★ **Serviced During Daylight Hours**

**MISSISSIPPI SUPPLY COMPANY**

ENDICOTT-ON-FOURTH BLDG., ST. PAUL, MINN. RAILWAY EXCHANGE BLDG., CHICAGO, ILL.

Railway Engineering and Maintenance

# Railways

## Efficient in National Defense

RAILWAY employees have long realized that the railways comprise the nation's first essential industry. It is only when crises arise, however, that they have opportunity to demonstrate anew the indispensability of the railways and to contribute of their energies to measuring up to this responsibility. They need, therefore, to be thoroughly conversant with the record that the railways are now making in meeting the public needs and with the outlook for future demands in order that they may, each in his individual capacity, prepare to meet these needs and thus contribute their full share to the program of national defense which is now the major objective of all.

### New Efficiency Levels

In the first place, the railways are today meeting the needs of the nation with an efficiency in use of plant and in service to patrons never before attained. Every employee, especially in the maintenance of way department, knows from the increased frequency of train movements which he sees, that there has been a large rise in traffic in recent months. Few realize, however, that the traffic being handled currently is heavier than in the World War year of 1918, whereas the facts are that the service now being rendered, measured in ton miles, is nearly one-fourth larger than in that year of maximum effort, with its priorities of shipments and other emergency measures devised to meet the critical war-time needs of that day.

Still more startling is the fact that the traffic that the railways moved during the first eight months of 1941 exceeded that handled in the same period of any previous year. This is in spite of the fact that the number of cars loaded in this period was 22½ per cent less than in the first two-thirds of 1929. This apparent anomaly arises from the fact that there has been a fundamental change in the character of the traffic now being handled, growing out of defense activities—a change that makes ton miles a more reliable measure of transportation produced than cars loaded. This change grows out of the sharply increased average haul of freight today as compared with that of even a few months ago—arising from the return to the rails of a large volume of trans-continental and other long haul traffic that in late years has been moving by coastwise and inter-coastal boats, and also arising in part from the increased movement of defense supplies and materials over longer distances.

Ton mile data are now available only for the first five months but other figures make it possible to estimate with considerable accuracy the performance for June, July and August. Through these means, it is estimated that the railways carried 297 billion tons of freight one mile in the first eight months of 1941, as compared with a maximum performance of somewhat more than 294 billion ton miles in the same two-thirds of 1929. And the magnitude of this achievement is increased still further when attention is directed to the fact that the railways now have on hand (July 15) 525,000, or 26 per cent, less cars in which to handle this traffic than in 1929.

Furthermore, the recovery in traffic is not confined to freight for the railways are now handling more passenger business than in any year since 1930.

### Preparing for Next Year

A performance such as this is outstanding at any time. It is particularly noteworthy in days such as these when all industry is disturbed and change and re-arrangement are found on every hand. It refutes the fears expressed earlier in the year by men in positions of high responsibility in government and industrial life that the railways would be unable to meet the demands and that a collapse in service was threatened.

But the railways are not content to rest on any laurels to which they may be entitled. Rather, they have drawn up for themselves an exacting program of plant expansion to add still further to their capacity. Not only have they reduced the percentage of freight cars awaiting repair to an all-time low, but they have ordered 120,000 new freight cars and 1,000 new locomotives during the first 8 months of this year. Furthermore, they have set for themselves the goal of still further increasing their freight car ownership (after replacements for all causes) by 120,000 before the fall traffic peak in 1942 and by another 150,000 before this time in 1943.

### Maintenance Preparations Also

But every railway maintenance of way employee knows that a railway is no better than its track and structures. It is reassuring, therefore, that managements are showing the same interest in these facilities.

This is evidenced by the expenditures for maintenance of way and structures. In the first six months of 1941, these totaled $263,685,434; they exceeded those for the same months of 1940 by more than $31,000,000, or 13.3 per cent; they were larger than for the first half of any year since 1931; they were nearly 80 per cent larger than in the low year of 1933. Even more significant is the rate at which these expenditures are increasing as the year advances, with the result that, whereas the total for the six months was 8.5 less than for the corresponding period of 1931, the amount spent during June, 1941, was actually greater by a half million dollars than in June, 1931 and it appears probable that the expenditures during the last half of 1941 will be sufficiently larger than during the same months of 1931 as to bring the total for the year above that for 1931.

It is because of the aggressive manner in which railway managements have moved to insure adequate railway facilities that railway purchases rose to 510 million dollars in the first five months of 1941, an increase of 214 million dollars, or 72½ per cent, over corresponding purchases in the same five months of 1940. These figures support the estimate that railway purchases for the full year of 1941 will exceed $1,300,000,000, and may even approximate the 1929 total of $1,389,000,000.

### Records To Be Proud Of

This is the record which the railways have made to date and are preparing to make in meeting the needs of industry in its all-out defense activities. It is a record which moved all the wheat that the elevator facilities of the country were able to receive, and they were prepared to move more; it is a record which is bringing to and taking from the lake ore carriers all the ore they can transport, with capacity for more; it is the record which caused President Pelley of the Association of American Railroads and Ralph Budd, transportation commissioner for the Advisory Commission on National Defense, a few days ago, to assure the United States Senate's committee investigating the oil shortages on the Eastern Seaboard that the railways were prepared to move immediately all the oil needed in that area, without awaiting the construction of pipe lines and drawing on the steel producing resources of the country therefor.

This is the record to which employees of the maintenance of way department can, with justifiable pride, direct the attention of those with whom they come in contact in their varied activities. It is a record also for which every employee in this branch of railway service bears a special responsibility because of the very nature of his work, in order that there may be no unavoidable delays in the movement of traffic (and thereby in the capacity of the railways to move the traffic being thrust upon them) due to derailments induced by failure of track or structures, to the slowing down of trains unnecesarily, to the use of equipment suitable for revenue loading or to any other conditions that lower the ability of the roads to render maximum service. And this vigilance must be increased during the weeks that are immediately ahead, when railway traffic normally reaches its greatest volume of the year, which volume will require, in the words of C. H. Buford, vice-president of the A. A. R., "That we'll have to do a little better job of railroading than we've ever done before. The shippers are doing a wonderful job in helping; we railway men can do no less." It is only as every employee is "on his toes" in every respect that the public may be convinced that its confidence in the railways is not misplaced.

## Supervision—

### More Important Than Ever Before

IMPORTANT as skilled planning and execution of maintenance of way and structures operations have been in past years, including those of the recent prolonged depression, it is doubtful if they were ever more important or essential than they promise to be in the months immediately ahead. As pointed out in the lead editorial in this issue, under the impetus of the country's huge national defense program, lend-lease activities and enlarged industrial activities generally, the railways are already producing more ton miles of transportation than ever before in their history, and the present fall months, the normal period for peak carloadings, promise to see ton-mile figures climb to still greater heights.

Every employee in charge of maintenance of way and structures work knows what this means for him. Enlarging traffic, with increased earnings, have always brought enlarged work programs, in part as a necessity to overcome increased wear and tear, and in part because the railways have the money to spend—and the days immediately ahead will be no exception, in spite of the fact that they will come on top of maintenance activities which, for the first eight months of the year, have exceeded those for a like period of any year since 1931.

Under even the most favorable general conditions, such prospects would call for the most careful planning and supervision of maintenance of way and structures work. Under existing conditions, with possible delays in the receipt of materials, the limited availability of cars for handling maintenance materials, a labor turnover that is becoming serious in many centers of the country, more limited detouring of traffic to simplify maintenance operations, a more insistent demand that work be done without interference with train operation, both passenger and freight—and the certainty that these conditions will become more serious—such careful planning and supervision are absolutely essential.

Under these conditions, it will be necesary for those who are supervising maintenance operations, from chief maintenance officer down to and including roadmasters, supervisors and gang foremen, to plan their work further ahead; to order materials, tools and equipment further in advance; to reorganize their gangs and working methods to meet changing traffic conditions; to prepare to house the transient labor that will be required to fill out the enlarged needs for men; to develop new assistant foremen and new machine operators, in order that efficiency will not suffer with deflections from the ranks; and, on top of all this, to strive to maintain the enviable safety record that has been built up by the maintenance forces of the railways in recent years. These added responsibilities will place a heavy burden upon those in a supervisory capacity, but they must be

faced and met if the maintenance forces of the railways are to do their part in meeting the unprecedented demands that are being made upon the railways.

To the end that these responsibilities will be met, and most effectively, maintenance officers must pool their ideas and experiences to an extent greater than ever before. Such interchange of ideas and experiences has marked the relationship of maintenance men for many years; has been responsible in large measure for the outstanding economies that have been effected in carrying out maintenance operations, especially in recent years; and, if continued and broadened in the light of the new and enlarged demands that are being made upon them, will go far toward solving the many perplexing problems with which they will be faced in the days ahead.

# Labor Camps

### A Returning Necessity On Many Roads

THE labor situation on the railways is changing rapidly. Enlarged work programs are calling for expanding forces at a time when the selective service laws, defense industries and projects and revived industry generally are drawing heavily from the ranks of skilled maintenance of way and structures forces, and still more heavily from the ranks of experienced furloughed employees and other stable classes of labor to which the railways have been able to look in recent years to meet enlarged seasonal requirements. Already in many territories, especially those embracing large industrial areas, the situation is becoming acute, not because there is a shortage of labor as such, but because of the shortage of labor with any railroad experience.

To make matters worse, many of the best of the men available must be housed to meet their needs for shelter and to insure their dependability on the job. Thus, the railroad camp, and camp car, among the most colorful elements of earlier days of railroading, but largely abandoned in the more densely settled areas of the country during recent years of labor surpluses, are coming back into the picture. Railroad divisions, and even entire roads, that have not maintained other than small emergency camps for a number of years, are now being confronted with the need for sizable camps. Accordingly, many maintenance of way supervisory officers will be called upon to establish, outfit and supervise camps—a new experience for many of them, and one which cannot be assumed lightly if the full benefit of the expense and trouble involved is to be realized.

Railroad camps in the active construction and maintenance years of the twenties were in marked contrast with those of the early days of railroad construction, some roads providing not only well-equipped bunk and dining cars, with electric lights and showers, but also recreation cars, and employing released passenger train cars for these purposes whenever possible. However, some railroad camps in years past have been constant sources of dissatisfaction to the men, sometimes due to their character, and sometimes due to their management or supervision. Where such has been the case, they have likewise been a source of trouble to the railroads.

It may be too much to expect to be able to satisfy the men in every respect, because some of them are unreasonable in their demands, but the extent to which they can be satisfied with comfortable and sanitary conditions, and provided with substantial, well-prepared food, will unquestionably, be reflected in better morale, increased production and a smaller turnover. These facts should not be overlooked as new camps are established, with either old or new equipment, and to the end that they are not, all new camps established warrant the attention of the higher maintenance officers, as well as of the roadmaster, supervisor and foreman in charge.

# Shortages

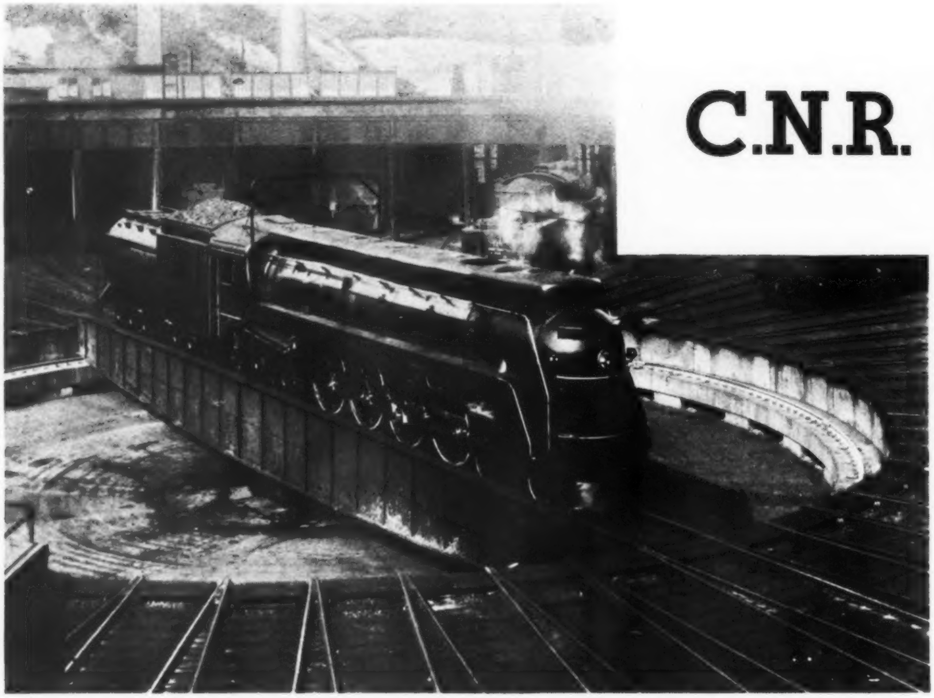
### Repeat Themselves on Larger Scale

MAINTENANCE officers today are working under conditions that are reminiscent of those that prevailed 25 years ago, yet there are wide differences between the two periods. During the former one, only a few types of work equipment had been developed, and all of the machines then available were crude by comparison with those of today. Today any one of the larger roads has a greater number of units of power equipment in service than was in use on all of the railways 25 years ago, if motor cars are omitted, and the value of these machines as an aid to maintenance is no longer open to debate.

Furthermore, for several years railway maintenance has been carried on with smaller forces than were employed during the worst man shortages of the former war, despite the far more severe demands that are now being made on track and other structures. During the present working season, however, in the face of a steady drain of younger men into the army and of older men into industry, the maintenance forces have been increased considerably and more work is being done in all branches of maintenance than in any year since 1931. The question that is disturbing maintenance officers, however, is not so much the present, but what the future will be, since traffic is increasing and train speeds that were unthought of 25 years ago are being maintained.

It was frequently difficult to obtain materials a quarter century ago, and deliveries were often slow, yet, despite the smaller manufacturing capacity of the earlier period, no such extreme shortages existed at any time as have already developed in almost all classes of materials during the present crisis, although for the country as a whole, preparations for defense are as yet scarcely under way.

In view of this situation, three courses are open to maintenance officers, all of which should be followed. They must use intensively the power machines they now have and purchase additional units for those needs that are not now covered, to insure the largest output per dollar expended. To the same end, they should examine their equipment critically, replacing with later models those units that are inefficient by reason of wear or obsolescence. They must develop and use still more effective methods for conserving the materials already in service. They should estimate their needs for the future, for both materials and equipment, and arrange their purchases so that they will be reasonably sure of deliveries when the need for them arises.



# C.N.R. Builds

The Turcot Yard Turntable in Operation, After the Circle-Wall Renewal Project Had Been Completed

**Recently the Canadian National found it necessary to renew the circle wall of the turntable at its 57-stall Turcot Yard enginehouse at Montreal, Que. Because this is an extremely busy location, it was necessary that the work be performed with a minimum of interference with the operation of the turntable. The problem was solved by constructing the new wall in precast concrete sections and installing them as the old wall was removed. We are indebted for the information contained in this article to C. P. Disney, bridge engineer, Central region, Canadian National, who originated the design of the precast wall and the method of supporting the rails**

WHEN the Canadian National found it necessary recently to renew the circle wall of the turntable at its busy Turcot Yard enginehouse at Montreal, Que., it adopted the unusual expedient of constructing the new wall in precast concrete sections which were installed one by one as the old wall was demolished and removed. Using this method, it was possible to renew the circle wall without interfering with the use of the turntable more than a few hours at any time during the project. Aside from the design and installation of the circle-wall sections, this project is also of interest because of the fact that, instead of the usual timber ties, the circle rail and the ends of the track rails are supported on and fastened to steel plate assemblies placed directly on the concrete.

## The Situation

The turntable at Turcot, which was constructed about 40 years ago, is 100 ft. long and is of the through-balanced type. It serves a 57-stall engine-house, and has one outbound and two inbound tracks. Originally the circle wall was of mass concrete construction, being about 4½ ft. by 8 ft. in cross-section, exclusive of the back wall which was cast integrally with the main wall. In recent years this wall had become badly deteriorated, this condition being ascribed largely to the fact that it had not been carried below the frost line and was, therefore, subjected to heaving and other destructive forces attributable to frost action. In the original wall the circle rail was supported on timber ties embedded in the concrete.

Several years ago the deterioration of the circle wall became so pronounced that it was decided to replace the wall in its entirety. Since this is an extremely busy location, with about 200 movements over the turntable in each 24-hr. period, it was necessary that the work be performed without taking the table out of service more than short periods at any time. The original plan was to construct the wall in sections in the final position, using high-early-strength concrete, but this scheme was abandoned in favor of the plan for precasting the new wall in sections and lowering them into position with a locomotive crane as the old wall was removed in sections of corresponding length.

## The New Circle Wall

Briefly, the new circle wall is comprised of 25 precast sections or slabs, which span between a series of concrete piers or footings, there being a pier at each of the joints in the circle wall. These piers are rectangular in horizontal cross-section and for most of their height they are 4 ft. by 6 ft. 10 in. in plan, the latter dimension being normal to the tangent of the circle. The top surfaces of the piers are level except that along the outside edge of each pier there is a raised lug, 3 in. high and 12 in. wide, which fits into corresponding mortise-like recesses in the outside bottom edges of the circle-wall slabs, thereby keying them in position. The piers were carried well below the frost line and were landed on hardpan, which was located at a depth of only a few feet below the bottom of the old circle wall. They range in height from 8.5 ft. to 9.5 ft., and extend to a depth of 14 ft. to 15 ft. below the base of rail at the track level.

# Turntable Circle Wall

## Of Precast Concrete Sections

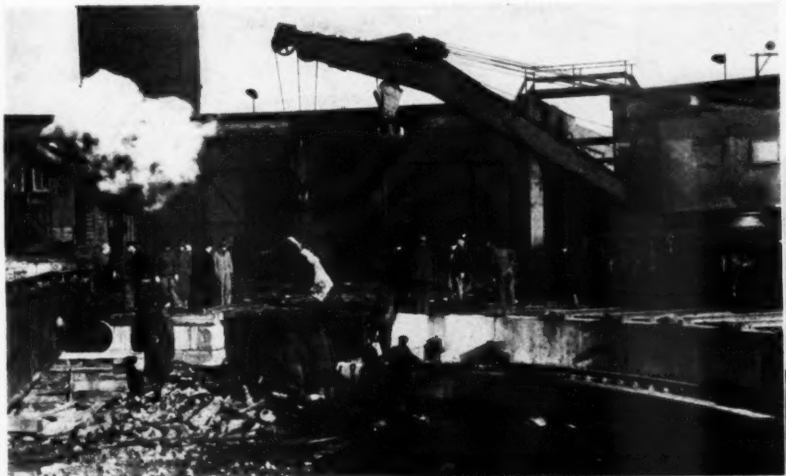
The circle-wall sections, which are curved to the proper radius, were each cast as a unit and are L-shaped in transverse cross-section, being 6 ft. 4 in. wide at the base and 5 ft. 3¾ in. high, measured from the base to the top of the back wall. The base slab of each section is 2 ft. in thickness while the back wall, owing to the fact that the rear face is slanted, varies in thickness from 2 ft. at the bottom to 1 ft. 6 in. at the top. Exposed corners of the sections were constructed with a 1-in. by 1-in. bevel. Ample reinforcement is provided in the form of round steel reinforcing rods and second-hand rails, there being three 56-lb. second-hand rails in the bottom of the base slab in each section.

Also, a length of 100-lb. rail, curved to the desired radius, is embedded in the top surface of the back wall of each section to provide an anchorage and a bearing for the steel plates supporting the ends of the track rails. These curved rails are in the inverted position, with the bottoms of the bases flush with the top of the back wall. To facilitate the handling of the circle-wall sections, they were each provided with two lifting stirrups, consisting of 1¼-in. round bars, which protrude from the upper surface of the base slab. For the most part, the circle-wall sections are 11 ft. 6¼ in long, measured along a chord at the center line of the circle rail, not including a ½-in. joint between the ends of the adjacent slabs. Each of the precast concrete sections weighed approximately 17 tons.

### Lap Joints

To insure that the sections of the circle wall will function as a unit, adjacent sections are keyed together by means of joints of the lap type. At each of the joints, the upper half of the base slab of one of the sections overlaps the lower half of the base slab of the adjoining slab a distance of 3 in. Also the forward half of the back wall of one section overlaps the rear half of the adjacent section the same amount, except that there is no overlap for a distance of 1 ft. 4¾ in. below the top of the back wall.

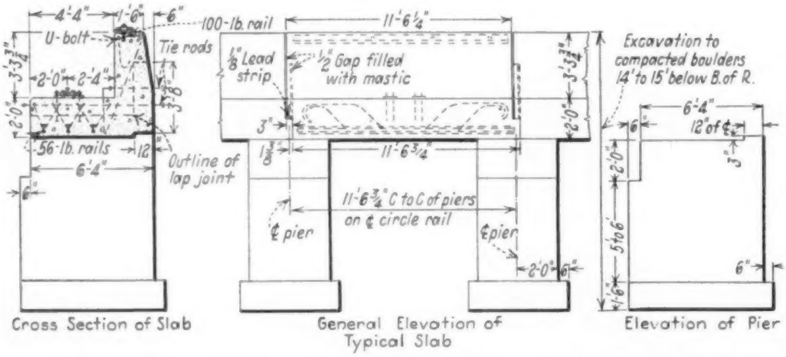
In other words, protruding lugs on the lower half of the base slab and the rear half of the back wall (to within 1 ft. 4¾ in. of the top) of one end face of each section engage corre-



Above—The Old Wall Was Removed Piecemeal as the New Precast Sections Were Inserted. Right—One of the New Sections About to Be Lowered Into Position by a Locomotive Crane

sponding mortise-like recesses in the end face of the adjacent section. At each joint, those portions of the end faces of the two sections below the lap in the base slabs fit tightly together, but above this lap the opposing faces are separated a distance of ½ in. and the space between them is filled with asphalt mastic.

Nine of the circle-wall sections were constructed and installed during the 1939 working season, while the remaining 16 were built and inserted in the following year. The work of constructing the sections was performed at a location convenient to the site of the turntable, which was accessible both to road traffic and to a locomotive crane. The forms were so constructed, with a foundation of ties and rails, as to permit them to carry a load of 500 lb. per sq. in. without settlement or distortion of the circle-wall slab sections.




**Showing Typical Details of the New Circle-Wall Slabs and Their Supporting Piers**

## Construction Procedure

In the 1939 program, the first step was to construct the key slab (with protruding lugs at both ends) which was to be the first to be installed. After the end forms had been removed from this section, the adjacent sections were cast in their proper position relative to the first, and so on, working progressively outward from the first section until all nine sections had been completed. Before undertaking the work of casting each successive section, a ½-in. well-greased board was placed against the face of the adjacent section in the area above the lap joint. Below this joint two plys of building paper were placed against the end face of the section to prevent a bond in the concrete.

In the meantime the work of constructing the piers for the nine slabs was under way. Of necessity, the piers were cast in position. This work was carried out under traffic, with the existing circle rail being carried across the excavation at each pier location by means of stringer rails placed under the ties. All of the ten piers that were required for the nine circle-wall sections placed in 1939 were completed before any of the sections were installed. Both the circle-wall sections and the piers were made with concrete which was designed to give a compressive strength of 3,000 lb. per square inch.

## Installing the Sections

The work of installing the precast sections was relatively simple. In placing the first nine sections, they were inserted in the wall at the rate of about two each day on successive days until all of them were in position. Immediately prior to the installation of the sections that were to be placed on a given day, the old circle wall at the locations of these sections was cut out with pneumatic demolition hammers, the larger pieces being removed with a crane. The new precast sections for these locations, which had previously been loaded onto a flat car and moved to the site of the work, were then lowered into position by a locomotive crane. In this work, the key unit was installed first, after which the remaining sections were placed progressively outward in both directions in the same order in which they had been cast.

## Lead Joints

Before each section was inserted, the ledges (both vertical and horizontal) of the protruding lugs on the end of the adjacent section were covered with ⅛-in. by 3-in. lead strips. After the slabs had been erected in the final position, the ½-in. joints between them were filled with asphalt mastic.

In the 1939 program, the concrete for the ninth circle-wall section was placed on October 20, and that for the tenth pier was poured on the following day. The first, or key, section was installed in the circle wall on Sunday, November 5, and the remaining eight sections were inserted on successive days thereafter at the rate of about two each day. During this period it was not found necessary to take the turntable out of service for more than about two hours in any one day. In the 1940 program, the work of constructing the piers and circle-wall sections and of placing the latter was performed in much the same manner as in the previous year.

## Rail Fastenings

As mentioned at the outset, the circle rail is supported on steel plates or chairs which are placed directly on the concrete of the circle-wall slab. These plate assemblies, which are similar to those used by this company to fasten rails to the decks of concrete-slab bridges, are spaced 1 ft. 5¼ in. apart, measured on the center line of the circle rail. Each assembly embodies a 1-in. by 6½-in. by 1-ft. 5-in. steel base plate which is held down by four 1-in. by 1-ft. 3-in. bolts cast into the concrete, the upper ends of which are fitted with spring washers and square nuts. At each plate assembly, two rail clips engage the base of the rail, each held down by a square nut, with spring washer, on a 1-in. by 3½-in. bolt with the head countersunk into the base of the plate. The circle rail is of 100-lb. section and was provided in 33-ft. lengths which were curved in the field.

Assemblies similar to those described above are used also for fastening the ends of the track rails to the top of the circle wall. At this location the adjacent rails of contiguous tracks converge at the rim of the turntable pit, the base flanges being trimmed to avoid their impinging on each other, and each pair of rail ends is supported by a single base plate. Also they are fastened together through their webs with track bolts which extend through timber filler blocks placed between them.

In each of the plate assemblies on the top of the circle-wall, the base plate is 1 in. by 12 in. by 2 ft. in dimensions and is held down by four square nuts, with spring washers, placed on the protruding ends of two 1-in. U bolts which are embedded in the concrete in such a manner that they hook under the 100-lb. rail in the top of the back wall. Each assembly embodies two clips for engaging the outside bases of the two rails, which are the same as those used for fastening the circle rail.

This project was carried out on the Central region of the Canadian National, of which F. L. C. Bond is vice-president and general manager and B. Wheelwright is chief engineer.


The New Erie Station at Suffern, N. Y., as Viewed From the Opposite Side of Tracks

**The Erie has built a small passenger station at Suffern, N. Y., which is noteworthy because of the fact that it incorporates the newer building materials and fixtures to an unusual degree. It is also of interest to note that the old station site was abandoned in favor of a location that greatly enhances the convenience and safety of passengers**

# Modern Materials Feature This Small Station

AN outstanding example of the application of modern building materials and fixtures in the construction of small railroad passenger stations is afforded by a structure that has been built by the Erie at Suffern, N. Y., a point on its main line about 32 miles from New York City. By taking full advantage of the availability of new types of finishing materials in their wide variety of attractive colors, the railroad obtained a structure that is exceedingly pleasing in appearance, both inside and out, and that is entirely in keeping with the present-day tendency among railroads to achieve the last word in building modernization, both in new construction and in the rehabilitation of existing structures. Incidentally, it is of interest to note that the new station is built on a plot of ground somewhat removed from the old station, which was purchased several years ago for this purpose when the railroad foresaw that the territory surrounding it was undergoing rapid development as a residential district and that it was becoming a center of population.


The Modern Finishing Materials Used Give the Waiting Room a Pleasing Appearance

## Previous Arrangement

Passenger traffic originating on the Erie at Suffern consists mainly of New York commuter business. Originally this business was handled at a frame passenger station built in 1886, which was located on the east side of the four-track line, that is, on the side adjacent to the westward tracks (outbound from New York). On the west side of the tracks, that is, on the side opposite the station, a passenger platform, together with a shelter shed, were provided for the use of eastbound (to New York) patrons.

Not only was the old station outmoded as to appearance, but its location on the westward side of the tracks was objectionable. Since the great preponderance of outbound business is eastward (to New York), it was necessary for many patrons to cross the tracks at grade to reach the eastward platform. The provision of a pedestrian subway or an overhead bridge offered one solution to the problem, but it was found that the cost would be almost as great as that of a new station, assuming that it

could be built at a location where it would not be necessary to construct a pedestrian tunnel or overpass across the tracks.

The plot of ground that was purchased several years ago provided such a location. It is situated about 1,100 ft. south of the old station at a point where a thoroughfare, known as Chestnut Street, is carried under the tracks in a subway. The roadway in the underpass is flanked by pedestrian sidewalks which could be utilized by railroad patrons in crossing from one side of the tracks to the other. The plot of ground, which is located west of the tracks and immediately south of Chestnut Street, provided ample space for a parking lot and is surrounded on three sides by paved streets. It was decided, therefore, to construct a new station at this point and to abandon the old structure. In addition to the presence of the subway, a station in this location would have the obvious advantage of being situated on that side of the tracks from which the greater part of the outbound business is handled.

The new station, which is situated at the track level, is a single-story structure and is rectangular in plan, being 18 ft. wide and 36 ft. long, exclusive of the overhanging eaves. The roof is double-pitched and is also pitched towards the ends at the gables. On all four sides of the structure the eaves overhang the walls about 3½ ft., and at the southerly end there is an attached canopy, about 13 ft. wide and 20 ft. long, which is continuous with the eave line on the track side of the building. Of standard frame construction, the station is supported on a concrete foundation.

### Exterior Features

The outside walls of the station are covered with gray cedar-grain asbestos-cement shingles applied over wood sheathing, while the roof covering consists of mottled green rigid asbestos shingles of the Dutch-lap type, placed over roof boards laid tight. Hence, there is a pleasing color contrast between the siding and the roof shingles. This contrast is further enhanced by the use of light and dark shades of green on the exterior trim, the light shade of which matches the green of the shingles.

On the station interior, the greatest part of the space is devoted to the waiting room, which occupies the full width of the building and is 19 ft. long. At the southerly end of the station are two small toilet rooms, while at the opposite end, across the waiting room, are the ticket office and a small baggage room. The ticket office is 9 ft. by 9 ft. 6 in. in plan, while the baggage room is 8 ft. by 9 ft. 6 in. These rooms are reached through outside doors and are not connected with the waiting room. The latter room is reached from the track side of the station by two doors.

The interior of the station reflects even more than the exterior the extensive use that was made of modern finishing materials. In the waiting room, the two toilet rooms, and the ticket office the interior finish is identical. The floors in these rooms are of marbleized asphalt tile in contrasting shades of gray and green. The tile was furnished in 9-in. squares and was laid in a checkered pattern on a substantial wood sub-floor to provide the necessary rigidity for this type of flooring.

### Flexboard Walls

Except for a wood base board, the walls are covered from the floors to the ceilings with decorative Flexboard in attractive colors, which is applied over a backing of Douglas Fir plywood ¼ in. thick. Incidentally, in applying the Flexboard, it developed that it was necessary to fasten the plywood securely with nails placed at frequent intervals. To a height of about 4 ft. above the floor the Flexboard is a slate color; above this level it is green. Adjacent panels of the Flexboard are joined together with aluminum molding strips at the horizontal joints. The ceiling areas are covered with cream-colored multiple bevel panels, ½ in. thick, which are grooved to form 12-in. squares. Unlike the other rooms in the station, the baggage room has a concrete floor and walls and ceilings of tongue-and-groove material.

The window sash in the station are of the double-hung multiple-pane type and are provided liberally, with the result that the station interior, especially the waiting room, has plentiful daylight illumination. All doors are of wood and those in the exterior wall of the waiting room are glazed in their upper portions in such a manner as to correspond with the window sash. The window and door frames and parts of the doors are painted a dark gray, while the window sash and the door panels are a light gray.

The ticket window is provided with a gilded metal grille placed behind a panel of plate glass containing necessary openings for handling business and for communication between patrons and the ticket agent. On the waiting-room side of the ticket window, and extending for several feet in both directions from it, there is a solid oak shelf. Ample seating capacity is provided in the waiting room by three oak settees, two of which are placed back to back while the other is placed along one wall.

### Florescent Lighting

Especially noteworthy is the fact that artificial illumination in the waiting room and the ticket office is provided by florescent lighting fixtures suspended from the ceiling. Each of these fixtures consists of two 48-in. tubes, four of which are installed in the waiting room and one in the ticket office. Lighting fixtures of the conventional type are employed elsewhere in the station.

In keeping with the remainder of the station, the fixtures in the toilet rooms are of the most modern type. Also a modern coal-fired hot-water heating plant is provided, which is located in a small concrete-lined basement room at the south end of the station. This room is reached from the outside by a concrete stairway.

As part of this project, a passenger platform 480 ft. long was provided along each side of the tracks at the station site, and at the northerly ends of these platforms stairways were constructed leading down to the sidewalk level in the street subway. The platforms are of bituminous construction on a crushed stone base and have creosoted timber curbs. Throughout the length of the station area an inter-track metal fence, transferred from the old station site, was provided. On the east side of, and parallel to the tracks, a paved thoroughfare lies directly adjacent to the company's property, and here a metal fence was also installed along the back side of the passenger platform. A small passenger shelter is provided on this side.

As part of this project, the plot of ground at the station site was graded for use as a parking lot and was covered with a 6-in. layer of cinders, thoroughly compacted with a 10-ton roller. Ample provision was made for drainage and catch basins were installed as necessary. To make the station and the parking lot readily accessible to street traffic, a U-shaped drive, with a bituminous wearing surface, was constructed, of which the entrance and exit ends connect with one of the flanking streets.

This station was designed and constructed under the general supervision of J. C. Patterson, chief engineer maintenance of way of the Erie, and I. H. Schram, engineer maintenance of way of the Eastern district. The work was under the direct supervision of B. Blowers, division engineer of the New York division, and G. C. Edwards, master carpenter. All of the work involved was performed by the division bridge and building forces.

The Heavy Accumulation of Old Paint Was Readily Removed by the Descaling Torch

# Flame Cleaning

## Removes Paint From Concrete Tunnel

**This article describes how the Erie, employing this method in a passenger tunnel at Jersey City, N J. to remove a heavy accumulation of badly deteriorated paint, found it highly effective, without causing any damage whatever to the surface of the underlying concrete**

WHEN THE Erie was confronted recently with the extremely difficult problem of removing a heavy accumulation of badly deteriorated paint from the ceiling of a concrete passenger tunnel to permit repainting, it experimented with the use of flame-cleaning and found this method so successful that it was employed on the entire project. By this method the heavy coating of paint was effectively removed in a rapid and economical manner without causing any damage whatever to the surface of the underlying concrete. As a matter of fact, it was reported that the concrete did not become heated at any time to the point where it was not possible to apply the hand to the surface.

This application of flame cleaning was made in a passenger tunnel which connects a concourse under the Erie's station tracks at Jersey City, N. J., with the Hudson & Manhattan Railroad, the latter being an underground line that operates by means of tunnels under the Hudson river, between New York City on the east bank and points in New Jersey on the west shore. For a distance of about 300 ft. from the concourse under the railroad's tracks, the passenger tunnel is maintained by the railroad.

### Details of Tunnel

The tunnel is rectangular in cross-section, with a flat ceiling except for curved fillets or coves in the corners between the side walls and the ceiling. For most of their height, the side walls are faced with tiles but the coves and the ceiling are of painted concrete. Hence, while the width of the tunnel is 14 ft., the total width of the painted portion, including the coves, is 18 ft. Thus the area of painted concrete in the 300-ft. section of the tunnel maintained by the railroad totals 5,400 sq. ft.

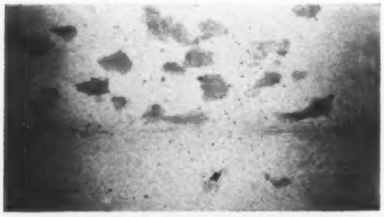
This tunnel has been in service about 34 years, and has always presented a serious maintenance problem because of the difficulty of removing the old paint prior to repainting. The ceiling was last cleaned in 1925, and from that time until the recent cleaning work was done, about 15 coats of paint, aggregating about 1/8 in. in thickness, were applied. Included in these 15 coats were both waterproof and casein paints.

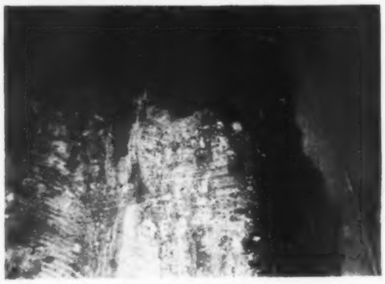
### Various Methods Tried

Recently, the paint in the tunnel had become so badly deteriorated it was decided that it would be necessary to remove all the old material down to the concrete before any more paint could be applied. Accordingly, various common methods of paint removal were tried, but all of them proved unsatisfactory for one reason or another. It was after these experiments had failed that a suggestion was made to try flame-cleaning. Therefore, an Airco Style 9200 torch with a 4-in. descaling tip was tried experimentally, and proved highly successful, the heat of the torch causing the several layers of casein paint to cockle and crack off, while the flame dried the waterproof paint to a powder which was easily removed by wire brushing. The flame operation further left the concrete surface free of moisture, maintaining this dry condition for the application of new paint. It was decided, therefore, to employ this method for removing all of the paint.

The force that was employed for carrying out the work consisted of a torch operator and two laborers, the duties of the latter being to wire-

brush the newly-cleaned surface, to handle the tanks of gas and to perform such other incidental duties as were necessary. The cleaning work was performed at night to entail minimum inconvenience to patrons. A





Above—This View Illustrates the Deteriorated Condition of the Old Paint. Below—A Section of the Tunnel Ceiling Showing (1) the Old Paint Surface (Extreme Right); (2) After Flame Application (Dark Portions); and (3) the Cleaned Surface After Wire Brushing (Light Portion)

ventilating system with which the tunnel is equipped was kept in operation while the work was in progress, to draw off the smoke and fumes created by the burning of the old paint coating. Also, those engaged in the work were provided with protective clothing, goggles and respirators.

Portable screens were employed to protect patrons using the tunnel, and care was taken to protect electrical conduit lines and other cables from the flames. Illumination is provided in the tunnel by a series of lights placed on the center line of the ceiling, and the protection of these lights presented something of a problem, which was solved by covering them with shades of galvanized metal when the burning operation was being carried on in their immediate vicinity.

### Rate of Removal

The removal of the paint was carried out at the rate of about 800 sq. ft. each night, the cleaning operation being completed in about a week. Because of the time spent in setting up the apparatus and in dismantling and removing it at the end of the work period, the cleaning work was actually in progress not more than six hours in each night's shift. The consumption of gases amounted to 0.42 cu. ft. of oxygen and 0.625 cu. ft. of acetylene for each square foot of the tunnel surface that was cleaned.

In repainting this tunnel following the paint removal work described above, aluminum paint was used as it was felt that a covering of this type would hold its color better than the white paints formerly used in this location and that it would be more durable. Two coats were applied, in both of which the aluminum pigment was carried in a waterproof vehicle. This passenger tunnel is subject to strong drafts, resulting from the movement of trains in the H. & M. tunnel, and, because these drafts rendered spray painting inadvisable, the repainting work was done by hand.

The work described in this article was carried out under the general supervision of I. H. Schram, engineer maintenance of way of the Eastern district of the Erie, and P. Sobbott, division engineer of the Terminal division. Manley Smith, master carpenter on the road at Jersey City, was in direct charge of the work.

# Deep-Well Turbine Replaces Air Lifts

AN example of the manner in which modern pumping equipment is being installed to advantage in the replacement of less advanced units, is provided by an installation that was made recently at the enginehouse of an eastern road. Formerly, the requirements for water at this point were served by two single-cased wells, 187 ft. deep, in which the water was brought to the surface by air lift and then raised by means of two centrifugal pumps to an elevated storage tank.

These wells were installed about 1916, and originally each of them had a capacity of approximately 250 gal. per min. Recently, however, the production of the wells had been greatly reduced as a result of the failure of the screens. Hence, it became necessary to give consideration to the question of augmenting the water supply, which could be done either by rehabilitating the old wells or by replacing them with new installations. On investigation, it was found that the expense of rejuvenating the wells would be only slightly less than the cost of replacing them, and it was decided to adopt the latter course.

Accordingly, a new gravel-wall well was drilled to the same depth as the old wells and a deep-well, motor-operated turbine pump with a capacity of 300 gal. per min. was installed. Later, it is planned to install another well and pump of the same type and size, and in the meantime the single-cased wells are being maintained in service as standby units to assist in serving the requirements of peak loads.

### Automatic Controls

The new pump, which delivers water directly to an elevated tank about 200 ft. from the well, is of the direct-connected Moturbo type manufactured by the Peerless Pump Company, and is provided with a weatherproof housing. Automatic control of the pump is achieved by means of a Mercoid regulator. Because of their lower cost of operation and maintenance as compared with the old pumping units, it is expected that the installation of the turbine pumps will result in material savings.

The New Pump Is Installed in the Open Near the Water Tank

# Roadmasters Accept Challenge of a New, Intensive Era

**Hold three-day convention in Chicago, September 16-18, with an intensive program geared to their needs as the railways strive to meet enlarging demands. Hear key men on material, labor and equipment problems; study six technical reports; and witness a large exhibit of the Track Supply Association. A complete report of the convention is published herewith, except for certain addresses, which will be published in subsequent issues.**

John J. Clutz
*President*
*Roadmasters' Association*

ACCEPTING the challenge that new peaks in speed and intensity of train operation are bringing to the maintenance of way forces as the country gears itself to new heights of industrial activity under the impetus of its national defense and lend-lease programs, members of the Roadmasters' and Maintenance of Way Association held their fifty-sixth annual convention in the Hotel Stevens, Chicago, on September 16-18, with an intensive program of reports and addresses designed to be of maximum helpfulness in meeting the enlarged responsibilities that face them in the days ahead. On every hand there was an atmosphere of seriousness and determination as members met session after session to grasp the full significance of the increasing demands that are being made on the roadway and track forces and to exchange ideas and experiences in the interest of meeting these demands successfully and with the greatest economy. The meeting, supplemented, as in past years, by an exhibit of maintenance of way materials and equipment, presented by the Track Supply Association, was attended by 386 railway officers, with a total attendance, including exhibitors, of more than 700.

The program, which was one of the most constructive in the long history of the association, was opened with an address by C. H. Buford, vice-president, Operations and Maintenance department, Association of American Railroads, who sounded the keynote for the entire convention in an outline of the large demands in prospect for rail transportation and a plea for the fullest cooperation on the part of maintenance of way men in meeting these demands successfully. Other addresses were made by B. R. Kulp, chief engineer, Chicago & North Western, on The Use of Cars and Locomotives by Maintenance of Way Forces in Times of Maximum Traffic Demands; by Fred S. Schwinn, assistant chief engineer, Missouri Pacific, on How We Can Meet the Requirements of an Expanding Program in a Period of Widespread Industrial Activity; by E. A. Clifford, chief purchasing officer, Chicago & North Western, on What We Face in Materials; by H. R. Clarke, engineer maintenance of way, Chicago, Burlington & Quincy, on What We Can Do About It; by A. E. Perlman, chief engineer, Denver & Rio Grande Western, on Streamlining Our Maintenance of Way Practices to Meet the Conditions of a Defense Era; and by G. R. Westcott, assistant engineer, Missouri Pacific, on What We Face in Equipment. Another address included in the program, and the special feature of the Tuesday evening session, was by Col. L. R. Groves, Quartermaster General's Staff, U. S. War Department, who discussed the extensive railway construction program of the War department.

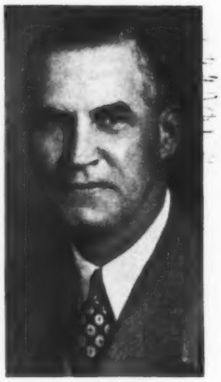
Technical reports were presented on Rail-End Wear—Causes and Correction; Roadway Machines—Off-Track vs. On-Track Types; Gravel Ballast—Its Requirements and Preparation; Recent Developments in the Renewal of Ties; Present-Day Roadway Drainage Requirements; and Maintaining Right-of-Way Fences—Organization and Methods.

Still other features of the program included the twenty-seventh annual banquet on Wednesday night, tendered to members of the association and their families by the Track Supply Association, which was attended by 683 persons, an all-time record; and a "Summing-Up" session on Thursday afternoon, addressed by G. L. Sitton, chief engineer, maintenance of way and structures, Eastern region, Southern, who reviewed the many constructive ideas developed during the convention.

All sessions of the convention were presided over by John J. Clutz, division engineer on the Pennsylvania, and president of the association. All of the committee reports, with abstracts of the discussions which followed their presentation, as well as abstracts of the addresses by Messrs. Buford, Kulp and Groves, are presented in this issue. The addresses by Messrs. Schwinn, Clifford, Westcott, Clarke and Perlman will be presented in subsequent issues.

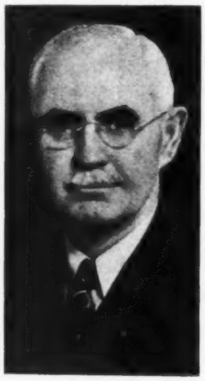
## Greetings

F. E. Morrow, chief engineer of the Chicago & Western Indiana—Belt Railway of Chicago, Chicago, and a past president of the American Railway Engineering Association, brought



A. B. Hillman
*First Vice-President*

E. L. Banion
*Second Vice-President*



F. O. Whiteman
*Secretary*

E. E. Crowley
*Treasurer*

greetings from his association, representing F.L.C. Bond, vice-president and general manager of the Central region of the Canadian National, and president of the A.R.E.A., who could not be present. "I like to think about our association and yours, as well as the different departments of our railroads," he said, "as a team in which each member has a particular part to play, and as each member improves his play, it reflects itself in a better team as a whole and in credit upon each of the other members of the team.

"It is necessary for the members of this team to be very versatile. The events of past years show that we go from one condition to another. In the last 25 years we have made the complete cycle. Back in 1916, we were in a period of rising costs and scarcity of materials and labor; then we went into the World war; and then into federal control. Following that, we went into a guarantee period, to be followed by a considerable period when things were relatively bright for the railways. Then came the depression, during which plenty of materials and labor could be had, but we didn't have the money to purchase them. Now, completing the cycle, we are going back into the 1916 situation where labor and materials are beginning to be scarce, and probably will become more scarce. But we took all of these things in the past in stride as they came, and I have no doubt that we will take the events which are to follow in the same way."

Bringing greetings from the American Railway Bridge and Building Association, H. M. Church, general supervisor of bridges and buildings of the Chesapeake & Ohio, and president of the association, stressed the value of cooperation between the members of the Roadmasters' and the Bridge and Building Associations, and called for still closer collaboration to the end that the members of both associations will be better equipped to meet the exacting problems of the days ahead. "Our associations," he said, "have a common purpose and our activities have always been closely related. A continuation of this spirit of co-operation will contribute to the up-building of the service on which we all depend."

## Roadmasters Association

### Officers 1940-41

John J. Clutz, president, division engineer, Penna., Indianapolis, Ind.
A. B. Hillman, first vice-president, engineer maintenance of way, C. & W. I.—Belt Ry. of Chicago, Chicago.
E. L. Banion, second vice-president, roadmaster, A. T. & S. F., Marceline, Mo.
F. O. Whiteman, 'secretary, Chicago.
E. E. Crowley, treasurer, roadmaster, D. & H., Albany, N. Y.

### Executive Committee

G. L. Sitton, past president, chief engineer maintenance of way and structures, Southern, Charlotte, N. C.
(Term Expires September, 1944)
P. Chicoine, roadmaster, C. P. R., Vaudreuil, Que.
R. L. Fox, roadmaster, Southern, Alexandria, Va.
(Term Expires September, 1943)
H. E. Kirby, assistant engineer, C. & O., Richmond, Va.
E. J. Brown, district engineer maintenance of way, C. B. & Q., Galesburg, Ill.
(Term Expires September, 1942)
R. S. Kniffen, general roadmaster, G. N., Duluth, Minn.
F. J. Liston, assistant superintendent, C. P. R., Montreal, Que.
(Term Expires September, 1941)
J. M. Miller, division engineer, W. M., Cumberland, Md.
C. M. Burpee, managing editor, Railway Engineering and Maintenance Cyclopedia, Chicago.

Citing a field for still closer co-operation than exists at the present time, he pointed out that in these days of improved tools and machines much can be accomplished in securing the maximum service and return from this equipment by co-ordinating the planning of the track and bridge and building forces. "The common use of trucks, compressors, cranes, etc.," he said, "can effect large economies in carrying out work and in the purchase of equipment. Closer co-operation too," he continued, "will enable the railways to provide still more dependable transportation, and thus impress upon the public still more forcefully the vital importance of the railways to national security."

Speaking in behalf of the Track Supply Association, C. E. Argust, its president and vice-president and secretary of the Morden Frog and Crossing Works, commended the Roadmasters' Association on its long record of achievements, and offered the fullest co-operation of his association and its members in aiding maintenance of way men in meeting the problems which lie ahead.

## President's Address

In his presidential address, President J. J. Clutz reviewed briefly the history and purpose of the association, and, more especially, its work during the last year, and challenged those present, in the face of the strenuous times ahead, to get the maximum benefit from the convention. Concerning general conditions on the railways and the attiude of management toward the association, he said, in part, as follows:

"During the last year there has been a heavy up-surge in railroad

traffic all over the country. This has resulted in larger maintenance of way budgets, the programming and execution of which have required continual close attention on the part of roadmasters. They have been busier than for many years and have had to be constantly on the job. In view of this," he continued, "and the importance of keeping traffic moving, management has not looked with favor on anything tending to take supervision away from their properties unless there was a very positive advantage to be gained thereby. Recognizing this, your Executive committee planned this as a 'Brass Tacks' convention to deal with the special problems with which we are all faced as the result of present conditions. The committee reports are unusually timely and stimulating. The addresses, to be made by nationally recognized leaders in the fields in which they will talk, will go to the hearts of our current common problems. That our managements have recognized the value of this program and have a high regard for the work being done by the Roadmasters' Association is evidenced by the fact that they have encouraged so many of you to attend this convention."

### New Officers and Subjects

At the closing session of the convention, A. B. Hillman, engineer maintenance of way of the Chicago & Western Indiana—Belt Railway of Chicago, Chicago, was advanced from first vice-president to president; E. L. Banion, roadmaster, Atchison, Topeka & Santa Fe, Marceline, Mo., was advanced from second vice-president to first vice-president; H. E. Kirby, assistant engineer, Chesapeake & Ohio, Richmond, Va., and a director of the association, was elected second vice-president; and E. E. Crowley, roadmaster, Delaware & Hudson, Albany, N.Y., was re-elected treasurer. Two new directors were elected — F. J. Meyer, roadmaster, New York, Ontario & Western, Middletown, N.Y., and A. L. Kleine, division engineer, Denver & Rio Grande Western, Salt Lake City, Utah; in addition, J. M. Miller, division engineer, Western Maryland, Cumberland, Md., whose term of office as a director expired with this meeting, was re-elected a director for two years, to fill out the unexpired term created by the election of Mr. Kirby as second vice-president.

The report of the secretary showed 794 members of the association in good standing, including 62 new members taken in during the year. The next annual meeting will be held in Chicago, in accordance with a provision in amendments to the constitution adopted, in which Chicago is named as the annual convention city. The subjects selected for study by committees during the ensuing year are as follows: The Use of Track Grinders; Extending the Life of Rail and Fastenings; Recent Developments in Tamping Practices; Highway Crossing Construction and Maintenance; The Maintenance of Roadway Equipment; and The Control of Injuries Under Today's Changing Conditions.

# C. H. Buford Sets Keynote in Address Opening Convention

C. H. Buford

IN AN address opening the convention, C. H. Buford, vice-president, Operation and Maintenance department, Association of American Railroads, spoke of his high regard for roadmasters and their accomplishments in the past, and then said, in part, as follows:

"For about a year this country has been trying in every possible way to expand production so we can become the Arsenal for Democracy, and there has been an increasing demand for rail transportation to keep materials moving for enlarging production schedules. Unless something unforeseen occurs, there will be need for much more rail transportation in the days ahead than we are providing today.

"I wish we knew just what this increase would amount to, but it seems impossible to get a correct estimate. Many people are making estimates, but they are far apart. As a result of this uncertainty about future transportation requirements, some people have tried, and are still trying, to create a feeling of uncertainty and confusion about the ability of the railroads to do a satisfactory job. For about three years this small group has been predicting that the railroads would fail and has urged that the government take them over to prevent this failure. I do not think the President or any cabinet officer wants the railroads to fail, or wants to take over their operation. They seem to have plenty of problems now, and I do not think they are looking for more.

### Problems Before and Ahead

"Most people who stop talking long enough to do a little thinking must realize that the United States is at war. When a submarine of one country shoots torpedoes at the battleship of another country and that battleship starts on a fishing expedition for the submarine, using depth bombs as bait, those countries are at war, neutrality acts, editorials and broadcasts to the contrary. Old Uncle Sam will listen to a lot of talk, but he will, in his deliberate way, pull off his coat and fight, and when he pulls off his coat a lot of people who have been talking about production are going to quit talking and are going to produce, and then things will begin to move, affecting the railroads.

"I mention these things because I realize that many of you were not in charge of maintenance work during the World War or the years immediately preceding it, and because there may be a repetition of the problems we faced during those times. One of the difficulties was the labor problem. Another difficulty that we encountered was a shortage of material. Many things occurred that forced us to change our methods of doing things, but we always found a way. During the recent depression years, you were short of men and material because there was not enough money coming in to pay for all the things you wanted and needed. Nothwithstanding this shortage, you found ways to maintain the tracks and structures so as to permit much higher train speeds than had been in effect previously. I think this accomplishment is more outstanding than anything that has previously occurred in railroad maintenance, and

all of you here today had a part in it.

"As business increases, with more trains moving, it may be increasingly difficult to release tracks for your use. You will get them for fewer hours each day and you may finally have to do most all of your work while maintaining traffic without delay. We have done this before, and can do it again. As the movement increases, there will be more need for cars and locomotives to handle commercial business. Transportation officers will not want to give you cars to load and they will look pretty sour when you ask for a work train because they might have some other need for the engine. Therefore, you should keep your requests for work trains to an absolute minimum, and when you get one, see that it has a full day's work, even if it is necessary to pool the work needed by several departments to accomplish this.

"Most roads are now working out plans to handle their current supplies of locomotive fuel with a smaller number of cars. Much is being accomplished in this program and I am sure much more will be done. I am not so happy, however, about revenue cars under load with company material other than coal. While it is true that within the last four months the average detention under load at destination for such cars has decreased until it is now less than one-third of what it was, it is still entirely too high, and you men here today are responsible for a lot of it. As the need for cars increases, and it will increase, you should see that your cars are unloaded promptly. All railroads acting through the Association of American Railroads have taken the position that cars will not be furnished for storage. This applies to shippers, and it applies to all company material as well. Your chief executive has agreed to the plan, and he is not going to be happy—and neither are you—if a check shows that you are letting cars lay around under load for long periods. I hope all of you will keep this in mind.

"As we become more deeply involved in war, we may have to contend with attempts to interrupt our service. Your patrolmen should be constantly on the alert for such things. Trespassing should be discouraged. See that there is no failure to inspect passing trains thoroughly and to make immediate report of anything that might cause trouble. Bear in mind that the business must be handled regularly and rapidly, which will call for the uninterrupted use of tracks. There may be places where trouble could occur from high water. Analyze these situations again and be sure you are prepared for any conditions that can reasonably be expected.

"Do not let the pressure of your daily work cause you to lose sight of the need for further improvement in your standards and methods of doing your work. You and those who supply the equipment you use in your work have made wonderful improvements during the last ten years, and this must continue at a rapid pace in the future. Do not let rumors or 'tough going' discourage you. Continue to handle your work in the same efficient way that you have in the past."

# Must Reduce Use of Revenue Equipment in Company Services

**By B. R. KULP**
Chief Engineer
Chicago & North Western, Chicago

B. R. Kulp

THEY say that the United States is not in the war, but I am not so sure of that. There is one thing, however, of which I am sure, and that is that the railroads of the country are now being subjected to traffic demands larger than ever before—demands that are as great, or perhaps greater than those made upon them during the peak year of the World War.

Since the fall of 1940, the railroads have been delivering an average of 5,000 carloads of defense material every day to 140 government defense plants, camps and other projects. I am informed reliably that not a single one of these projects has been delayed as the result of any failure in railroad transportation. This record is a credit to our industry and is one that must be maintained.

Along with this achievement, it is a known fact that the railways have fewer cars and locomotives than they had in 1929. Nevertheless, during 1940 they made a new high record in operating efficiency. The average amount of freight carried per train was greater than ever before, and this freight was transported at an average speed never surpassed. This was made possible in large measure by better equipment and a better track structure—locomotives will handle trains of heavier tonnage; cars are in better condition; more care is taken to see that each car is loaded to capacity; and the roadbed has been improved through heavier rail and better ties and ballast.

As you know, the business that is now being offered to the railways consists largely of all kinds of war materials and is consigned to various ports along both our east and west coasts. This material must be delivered, and I am satisfied that our railroads can and will handle the job 100 per cent. In addition to these materials, we must not forget our own need, that is, the materials going into the many defense projects being erected all over the United States by our federal government. You must remember that all of this business is in addition to the traffic carried by the railroads during normal times.

I mention all this to impress upon you the vast volume of business that is being offered the railroads today, and to point out that in order that the railroads can handle this business, it is necessary that each of you do your part in seeing that every car is kept in active service. To illustrate what I mean, let me take all the cars in service on all of the roads of the country today and create what we may call an average car. While this car will be in service the full 24 hours of the day, its daily forward movement, on the basis of average performance, is only 42.6 miles, and the average time of movement is only about 2½ hours. So you see that, on the average, 21½ hours out of each 24 are lost to car movement. How can this lost time be saved and the forward movement of the average car increased?

You men who have to do with

maintenance and construction can all do your part by observing the following suggestions: Analyze your work-train requirements more carefully; give the operating department adequate notice as to when and where equipment will be required; discuss your work-train requirements with your operating department officers so that the closest possible co-operation can be obtained; co-operate with other departments, combining requirements where possible, thereby eliminating additional work-train service; investigate the possibility of utilizing a regularly-scheduled train for a couple of hours, thereby eliminating the necessity for a full-time work train; secure the co-operation of your superintendents, train dispatchers and other division officers in order to keep your work trains moving with as little delay as possible; and load cars to maximum capacity consistent with car capacity and safety.

Among other things, give preferred attention to foreign cars and consideration to the class of equipment ordered and to the direction the load is to move. For example, on the road with which I am associated, stock cars move empty westward. With this in mind, all classes of company material that can be loaded in stock cars westbound are moved in this class of equipment.

Furthermore, extra precautions should be exercised at this time of maximum traffic demands to guard against all possible damage to equipment while it is under your jurisdiction, and still further, maintenance men should be on the alert when trains are passing to observe defective equipment, such as hot boxes, defective brake beams, car wheels, etc., and warn engine crews when any defects are noted. In case such warnings are not observed by train crews, the train dispatcher should be notified as promptly as possible.

Last, and of possibly greatest importance, unload equipment promptly and release it as soon as it is unloaded. I noticed recently in a release by the Association of American Railroads that the government agencies and contractors involved in the large-scale defense projects referred to previously are unloading and releasing cars in an average time of only 1¾ days per car. A recent check on our railroad of company material under load indicated definitely that we all had a job on our hands to equal this record. Since we are expecting industries to release cars promptly, it is not unreasonable to expect that you men, if necessary, will be required to equal their record in releasing cars loaded with company material.

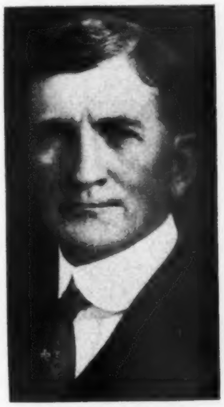
The drive to release cars from company material service to revenue service continues. W. C. Kendall, chairman of the Car Service division of the A.A.R., stated recently that "as of August 15, we were able to show a reduction of 3,000 cars loaded with company coal, as compared with August 1, and a reduction of 900 cars loaded with other company materials."

A campaign on the road with which I am associated has reduced the time for cars under load with company material from approximately four days to two days, and we are striving to make further reductions. If each of you will keep in mind that every piece of equipment that you might have tied up on some maintenance or construction project is required *now*, and bear in mind that the equipment may be necessary to transport materials of vital importance to our national defense, I am sure that you will do your part in aiding the railroads to build up a record of transportation that will be long remembered.

# Rail-End Wear—Causes and Correction

**Report of Committee**

THE Scriptures say that "The poor ye have with you always," and this may throw some light upon why we are always finding so many troubles in rail joints. Certainly, the rail joint is the poorest part of railway track, and unless we can find some way to rid the tracks of joints, we will have these poor spots with us always.



**C. W. Baldridge**
*Chairman*

The responses received from members of the committee to a request for information show clearly the value of the work of this association, for nearly all of the members reported the use on their roads of practices which are very close to the recommendations which have been made by this association from time to time during its many years of activity.

The subject assigned to our committee covers a number of factors in railway maintenance. Rail-end wear takes in not only the abrasive wear of the heads of the rails at their ends, but includes also the batter, the chipping, and the failure of the rail ends in various other ways; also, the wear of the bearing surfaces of the tops and bottoms of the joint bar and of the corresponding contact surfaces of the rail head and base; the bending of the rail and of the joint bars; the wear of the bottom of the rail and of the top of the tie plates; the wear and failures of the bolts, nuts and washers or springs; and finally, the ties, ballast and roadbed, particularly as to drainage. Is it any wonder that some members of this committee, practical trackmen as they are, state that 75 per cent of track maintenance labor is applied at or near the rail joints?

## Rail-End Chipping

Following the order set up in our subject assignment, it is appropriate first to list the kinds of rail-end wear and failures which must be considered. The most common type of rail-end wear is the battering of the top faces of the rails due to the pounding of the wheels in passing over the joints. In many cases the battering of the rail ends is greatly increased by the chipping out of a flake of metal from the head of the rail at the end, and the thicker the chip the greater is the amount of batter resulting.

In the days when Bessemer steel rails were used, far fewer chipped ends and less batter were found than is the case today, but at that time, wheel loads and the density of traffic were less than they are now, and cer-

tainly the speed of train movements was much less. The greater amounts of wear and batter under present conditions are offset to a considerable extent by the fact that we now are able to build up the rail ends by welding, thereby extending the life of the rails and providing better-riding track.

### Earlier Type Largely Overcome

The earlier type of chipped-end rails usually had its inception in the metal in the heads of the rails flowing toward the ends and producing an overhang or projecting lip at the top. In cold weather, when the contraction of the metal in the rail opened up wider spaces between the rail ends, these overhanging projections extended into the gap between the rails and did little or no damage. However, when the expansion of the steel, due to warmer weather, brought the rail ends together, the pressure produced between the projections caused a chip of metal to break out of the head of one and sometimes both rails.

In recent years, the practice of hardening the running surface of the rails at the ends by means of heat treatment, and the cross grinding of the upper edges of the rail ends, have largely remedied the old kind of chipping. But recent experience indicates that the heat treatment causes some rails to develop chipping, which crumbles out in small pieces. Also, in some cases, rail ends which have been built up by welding develop chips which cover the end of the rail to a depth which is dependent upon the depth of the weld.

Figure No. 1 shows, in the center vertically, a medium depth of chip which seems to have resulted from a horizontal split, or fissure, due to a flaw or seam in the steel. The chips on both the right and the left appear to be due to weld failures. This figure, at the top, shows a view of the face of each chip; in the middle, a view of the end of each chip; and at the bottom, the fracture faces of the chips. Note that the end views show cross grinding on the two outside chips, but none on the center chip. The center chip came from a rail which is known to have been cross ground shortly after laying, and where it is also known that no building up by welding occurred.

### Other Types of End Failures

Another type of failure which has been found in recent years, but rarely if ever in earlier times, is a head failure at the end of the rail. In this kind of failure—(Fig. 2)—the head of the rail breaks out at or near the junction of the head and web and usually extends back only to the first bolt hole or very little past it. It seems that this kind of failure is due to loosely bolted joints, where the bolt holes are large enough to allow the leverage of the angle bars to bear against the head of the rail, without bringing vertical pressure between the bolt and the web of the rail surrounding the bolt hole.

Still another type of rail-end failure is the bolt-hole break shown in Fig. 3. Such failures almost always, if not always, show considerable wear of the bearing surfaces of the head and base of the rail and the joint bars, indicating loose bolts and poor support from the ties. In this case it seems that the contact between the bolts and the rail metal surrounding the bolt holes is effective before very much force is brought about between the head of the rail and the tops of the angle bars.

This type of failure is found most often where poor ballast, such as mixed gravel and marine shells, is used for the track support. It is found less often in dirty gravel ballast and still less often where better ballast is used. Also, even in poor ballast, bolt hole breaks, in nearly all cases, occur at joints which are buried at highway crossings, motor car set-offs, platforms, etc., where the necessity for pulling up planking or other filling-in material to tamp up low spots in track, causes loose joints to be neglected.

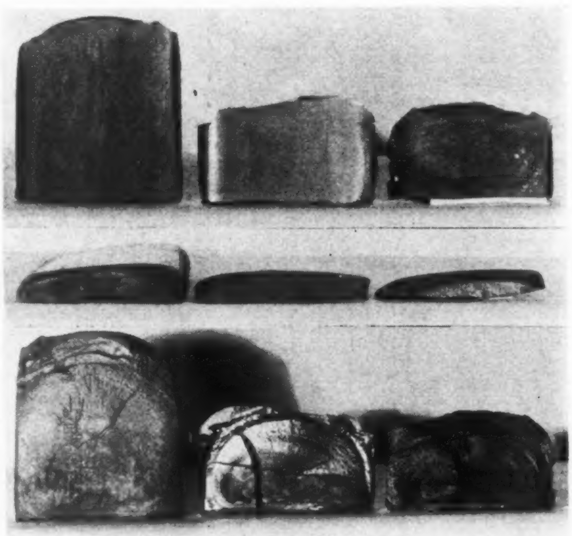


**Fig. 1—The Top Faces, Ends and Fracture Faces of Three Sizable Rail End Chips**

### Joint Bar Failures

In addition to the failure of rail ends, as already outlined, the failure of joint bars is a factor of much importance. In the early days of railroading, joint bars were but flat iron bars bolted against the webs of the rails to keep them in line, with no thought of bridging the wheel loads from one rail to the next. Experience soon proved that the rails had to be so joined together that the wheels could pass from one rail to the next with as little jolt as possible. It seems that the first plan adopted for this purpose, after the strap joint, was the rail chair joint. The rail chair joint was designed to be supported upon a single tie, with equal lengths of the adjacent rails bearing upon the chair and held in line by shoulders across the plate, very similar to the present-day double-shoulder tie plates, which are intended to keep the rails in line.

### Development of Joint Bars

The next development was the fish-plate joint bars, which were designed to make contact with the head and base of the rail by fitting into the top and bottom slopes of the fishing space, but which were not allowed to make contact with the web of the rail. This was a great improvement over the previous types of joints, but was still not enough. Therefore, some engineer brought forward the idea of adding more metal to the fish plate to give it greater strength. As it was not practical to add much metal at the top, the increase was added at the bottom, with the angle bar resulting.

To provide against the creeping movement of the rail, the base of the angle bar was made to extend far enough beyond the base of the rail to permit the punching of spike slots and the anchoring of the rails against creeping by spiking in the slots. Some damage to the rail ends is caused by the movement of the ties and the dis-

turbance of the ballast which results invariably from this method of anchoring the rails against creepage.

### Building Up Rail Ends

To combat wear and failures of rail ends, it is necessary that, in so far as is possible, each case of wear or failure be met with a proper remedy. The abrasive wear throughout the running surface of the rail cannot be avoided, but might be decreased through improvement in the wearing quality of the steel by incorporating greater hardness or toughness. Rail-end batter may be, and usually is, exaggerated by a bending down of the joint bars and the rail ends. To correct such batter, the amount of abrasive wear of the bearing faces of the joint bars and of the head and base of the rails—also the bends in the bars and rails—should be taken care of along with the surface batter.

On most railways it is considered advisable to build up rail ends when the combined batter and bending shows three one-hundredths of an inch or more low. The proper procedure to be followed in making such repairs has been improved in recent years to consist of removing the joint bars and then, after cleaning and oiling them, to reverse and reapply them. After they have been reapplied, the joint ties are properly tamped up to surface, and then those rail ends which require it are built up by welding, using either the gas or electric process.

In repairing rail ends, they should be built up slightly higher than the desired finish, and then ground back to a true surface by means of a power-driven grinder. If this practice is not followed, the welds which chance to be built too high must be brought back to the correct height by the use of a "flatter" and a sledge hammer. It is difficult to do a good job of finishing the surfaces of the rails with a "flatter" because the spread of the flame of the torch is not wide enough to bring to a forging heat at one time all of the width of the rail head necessary to allow the spreading and lowering of the excess metal to the desired surface by that means.

### Flatter-Finished Welds Low

A recent check of newly-built-up rail ends (some of them while still hot) where a flatter finish was depended upon, showed that 75 per cent of the joints inspected were from 0.01 to 0.02 in. low. The welders had become overly careful not to build up the rail ends to such an extent that the flatter must be used. If a grinder had been available, the welds would have been finished a trifle high, then ground back to a true surface at very little, if any greater, cost. In addition, it would have permitted the cross-grinding of the rail ends.

Where the batter and wear are heavy and the bending of the joint bars and rails is considerable, it is best to have the joint bars reformed to correct both the bend and the wear, or to secure new bars made to refill the wear of the rail. After reapplying the bars, the joint should be surfaced,

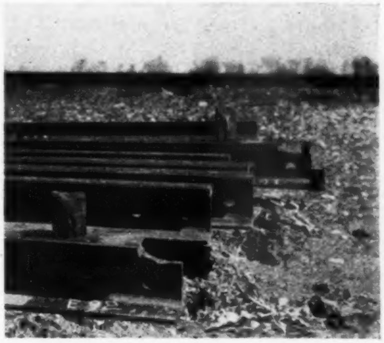


Fig. 2—A Head Failure at the End of a Rail, Showing Piece Broken Out

and then the rail ends should be built up by welding, following with the grinder, as already set forth.

### Spot Joint Welding

It is not uncommon to find in railway tracks an occasional joint where the rail ends are battered or chipped much more badly than the average. Such cases are sometimes so bad that the rail, or rails, involved are removed from the track. Where cases of batter of about 0.06 in. or more are found, it usually becomes a question of whether to remove the rail from track and replace it with a renewal rail, or to send a welder to repair it in place. The only other alternative is to leave it in place and to have trackmen spend the time necessary to tamp the joint up at frequent intervals. The members of this committee who answered a question on this subject give the cost of tamping up such a joint as from ¾ to 2½ man-hours, and estimated that such a joint will require resurfacing at least four times a month, and usually twice each week.

To send a welder and helper out to build up such joints will cost from about $1.50 to $3 per joint, depending largely upon the frequency of the battered ends to be built up. To change out the rail and move it to the tool house will cost not less than $5 per rail, with the repair of the rail and further handling yet to be accounted for. On a heavy-traffic railway, it is more than probable that the maintenance of a welding gang on each roadmaster's district to take care of such bad rail ends, as well as to repair worn frogs and switches, would be an economical practice.

### Out-of-Face Welding

Another question which comes up in connection with the building up of rail ends is that of building them up "out-of-face." According to the Manual of the American Railway Engineering Association, the term "out-of-face" means—"Completely and continuously over a given piece of track, as distinguished from work at disconnected points only." All members of this committee who answered the query on this subject gave 0.03 or 0.04 in. as the amount of batter which justifies the building up of rail ends. Also, they gave 50 per cent, or more, battered joints, as the number which will justify out-of-face welding.

It seems doubtful, however, that out-of-face welding can be justified, for in measuring up the amount of batter of rail ends, even in track which is scheduled for renewal of the rails, an occasional joint will be found which is not more than 0.01 in. low, and many more joints will be found which are not more than 0.02 in. low. Rail ends which have carried traffic to such an extent, with not to exceed 0.02 in. of batter, cannot be improved very much by welding, and they may be damaged instead.

Where the cost of building up rail ends is reckoned in cost per joint, these slightly worn joints, which require but little work to be done upon them, bring down the average cost per joint. However, if the cost is figured on a "per mile" basis, every joint which can be skipped lowers the cost, not only per mile, but also in fact.

### Corrections for Chipping Due to End Hardening

If a large number of chipped-end rails are found among rails which have been end-hardened, it may be advisable to try to remedy the trouble by again heating the rail ends and providing some means for retarding the rate of cooling. Quick cooling of steel hardens it, while slow cooling softens it.

If only a few rails develop the deep chip failures, the best remedy is apt to be building them up by welding. If the chipping is too deep for welding, the rail can be cut off, one foot or more, and reused where a short rail is needed. If horizontal fissure chips occur, make sure that the cut is back to sound metal.

Head breaks at the ends and bolt-hole breaks can likewise be cut off,

and the rails reused as short rails. This can be done with safety because these types of failures are the result of neglected maintenance and represent no indication of faulty metal. The correction for these types of failures consists primarily of giving closer attention to joint maintenance in crossings and at other points which are difficult to get at.

### Correcting Failures of Bars

Not much can be done to prevent failures of joint bars after they are delivered for use, so new bars should be built for strength and accurate fit,

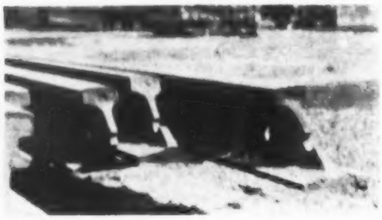


Fig. 3—Bolt-Hole Breaks Almost Always Indicate Loose Bolts and Poor Joint Support

and the flange should not be slotted for spikes. More joint bars of types in general use have broken from the corner of a spike slot than from any other cause. This is because of the sharp angles of the spike slots. Some joint-bar failures seem to result from the impact of unbalanced engine drivers, when such blow chances to strike at a joint, while others are due to the bars having been overheated preparatory to shearing and punching.

Both bars of a rail joint seldom begin to show cracks at the same time, but if one bar becomes cracked or broken and is left in service, it is natural that the opposite bar will become overloaded and will fail. If reasonable watch is kept for cracked joint bars, and if those found to be cracked are replaced promptly, there is practically no danger to trains.

Many joint bars become worn to such an extent that the rail ends cannot be kept in good surface. In many such cases the bars can be corrected by removing them from the track and having them reformed, or by having the worn parts of the bars restored by welding. In some cases the wear of joint bars is overcome by the use of metal shims inserted between the bars and the rail. Some roads have found their joint bars bending downward at the centers, thus causing low spots in the track, and have devised methods of overcoming this by straightening the bars in the track.

Present-day wheel loads of locomotives, along with the high impact forces which result from modern high speeds, cause excessive stresses in all parts of the track structure. This results in very high bolt tension, frequently applied, and causes many bolt failures.

If the bearing faces of the joint bars, and of the underside of the head and the top side of the base of the rail, were made horizontal, the reactions of wheel loads passing over the rails would be 100 per cent vertical, with no outward thrust on the joint bars and bolts. With each bearing face being at 14 deg. from the horizontal, however, a horizontal component of the force, or the load, results. This horizontal component of the load passing over the joint, multiplied by a trigonometrical function of the combined angles, gives the amount of the force which acts upon the bolts. The calculations and tests made by a committee of the American Railway Engineering Association show that for a 40,000-lb. wheel load passing over a joint, the stress in the bolts would normally be between 7,000 and 8,000 lb. Therefore, a tension of 2,000 lb. in each bolt of a four-bolt joint should be sufficient to keep the joint bars in proper position.

Experience has shown that it is desirable to use some form of washer on each track bolt which has enough spring power and spring travel to maintain at least 2,000-lb. pressure per bolt on the joint bars for an appreciable distance of travel, to offset the loss of pressure due to the wear

Fig. 4—Welding Has Proved Effective in Correcting Many Rail End Failures

of the joint parts and possible fatigue of the metal. The tension of the bolts should be kept as nearly uniform as possible, and care should be used not to run nuts up too rapidly when using machine bolters.

It is difficult to determine the actual bolt tension in joints, for the reason that many track bolts are rolled with a slightly tapering threaded portion or with slightly distorted threads. This increases the torsional force required to tighten them, and in some cases bolts are broken before they have even drawn the joint bars to full contact.

To prevent the freezing of the joints, the bearing faces of the bars and rails, and also the bolts, should be well oiled before application.

### Maintenance of Joints

Care should be taken to keep the track well drained, especially at and near the joints, for wet spots in track soon become low spots, causing pounding and batter of the rail ends, and as the low spots get lower, more water settles into them. Rail-end wear makes necessary larger maintenance expenditures than any other track weakness or failure. It seems, therefore, that the elimination of rail ends is so desirable that much greater effort and study should be devoted to the subject of continuous rails than has as yet been given.

Committee—C. W. Baldridge (chairman), asst. engr., A. T. & S. F., Chicago; J. H. Dunn (vice-chairman), rdm., N. Y. C. & St. L., Ft. Wayne, Ind.; G. W. Benson, supvr. b. & b., C. of Ga., Macon, Ga.; R. W. Bonney, gen. rdm., S. A. L., Jacksonville, Fla.; M. D. Carothers, div. engr., Alton, Bloomington, Ill.; M. L. Denny, supvr., I. U., Indianapolis, Ind.; H. E. Durham, rdm., K. C. S., Pittsburg, Kan.; F. L. Etchison, gen. rdm., A. C. L., Rocky Mount, N. C.; R. H. Gilkey, div. engr., C. of Ga., Savannah, Ga.; W. Goodwin, III, supvr., Sou., Winston-Salem, N. C.; W. H. Haggerty, supvr., N. Y. N. H. & H., New Rochelle, N. Y.; G. S. King, supvr., Sou., Blackville, S. C.; J. D. Kirkland, supvr., C. R. I. & P., Topeka, Kan.; F. B. Lafleur, rdm., S. P., Lafayette, La.; W. H. McNairy, supvr., Sou., Branchville, S. C.; J. M. Miller, div. engr., W. M., Cumberland, Md.; P. F. Muller, rdm., C. & W. I., Chicago; D. V. O'Connell, rdm., C. & N. W., Chicago; C. W. Russell, rdm., Sou., Greenville, S. C.; L. M. Denny, supvr., N. Y. C., Indianapolis, Ind.; G. L. Sitton, ch. engr., m. w. & s., Sou., Charlotte, N. C.; and J. A. Rust, rdm., Sou., Winston-Salem, North Carolina.

## Discussion

A. Chinn (Alton), pointing out the difficulty of ever attaining conditions at barred joints comparable with those in the main body of the rail, said that he looked hopefully to the day when longer rails would become readily available. In this, Chairman Baldridge agreed, stating that an A.R.E.A. committee was studying this specific problem, looking forward to the time when long rails will be the rule, with little rail less than 1,000 ft. in length in the track.

Answering a question, G. L. Sitton (Sou.) said that many thousands of joints on his road had been built up

by the oxy-acetylene method, and that so far as he was able to discern, there was no greater rate of breakage in these bars than in any other bars in the track.

Several members, including E. L. Banion (A.T. & S.F.) and Mr. Chinn, felt that reformed bars were more satisfactory than built-up bars. Likewise, there was a general feeling that there is an important place for metal shims in overcoming joint bar wear, it being pointed out, however, that to secure effective and satisfactory results, the wear at each joint must be measured with precision and the proper size shims applied.

E. E. Crowley (D. & H.) spoke conservatively of the advantages of the continuous welded rail on his road, but admitted that routine maintenance in the territories laid with such rail was somewhat less. He cautioned, however, that they still have problems of line and surface where such rail is laid, and that some of the welded joints have shown apparent signs of secondary batter.

O. Suprenant (D. & H.) was more favorable to the continuous rail construction, pointing out that, in his experience, maintenance costs were reduced sharply.

Changing the subject, Mr. Banion cautioned against the indiscriminate building up of rail ends; he stressed the need for seeing that the ends of new rails are of exactly the same height when laid in the track; and urged the necessity of finishing rail-end welds to a perfectly true surface. Referring to that part of the report dealing with chipped rail ends due to expansion and rail creepage, Mr. Suprenant pointed out that much of such rail damage could be avoided through the use of an adequate number of rail anti-creepers.

Professor R. E. Cramer (U. of Ill.), spoke at some length of the rail investigations that have been conducted at the University of Illinois, and brought out that many cracks in the ends of rails, resulting in chipping, had been found to be due to corrosion fatigue, developing as the result of cross grinding. He said that greasing the slot surfaces had been found effective in preventing such failures.

At another point in the discussion, the importance of properly oiling or greasing joints, especially in the fishing areas, was brought out, as well as the importance of proper bolt tension. In the latter regard, Chairman Baldridge stressed the value of a suitable coil spring washer, both in determining the proper tension in joint bars initially, and in maintaining this tension. It was also brought out that great care should be exercised to apply joint bars properly, and that when power wrenches are used to tighten bolts, the nuts should not be run up to a tight fit too rapidly. In this regard L. M. Denny (N.Y.C.) said that on his territory he uses power bolting machines only in high gear, finishing the tightening of all bolts by hand.

# Off-Track Versus On-Track Roadway Machines

**Report of Committee**

The relative merits of Off-Track and On-Track roadway equipment are of vital concern to every maintenance officer. Managements are not inclined to authorize the purchase of expensive equipment unless definite savings can be shown. Data must be presented to show the savings that can be effected and the advantages resulting from the operation of the machines desired. The acceptance by railroad managements of the economies of power tools and work equipment is strikingly manifested by their yearly purchases of these machines. More than seven and one-half million dollars were spent last year for work equipment, a large portion of which was of off-track types.

**A. L. Kleine**
*Chairman*

An example of the savings possible through the use of off-track machinery in roadway operations has been demonstrated by the Denver and Rio Grande Western. In 1937 its dirt and rock-handling equipment consisted of 11 steam ditchers and 4 2½-cu. yd. track-mounted steam shovels. The work train expense in 1937 was $348,000. By 1940, the majority of these machines were scrapped and replaced by a number of crawler draglines, shovels, bulldozers, and front end loaders, at a cost of $85,000. The work train expense in 1940, when more than twice the amount of work was done than in 1937, was $53,000, a saving on work train expense alone of nearly $300,000. In addition, a further saving was effected in the cost of the work done by off-track machines as the operators lived in outfit cars near their jobs and worked their machines almost continuously, while the on-track machines suffered frequent delays due to their going to and from their work from their tie-up points and due to train delays.

### Crawler Draglines and Bulldozers

Crawler draglines and shovels can be used economically on bank widening, ditching, filling bridges, line changes, channel changes and many other types of work. In May, 1941, six of these machines, varying in capacity from ⅜ to 1¼ cu. yd., and doing the types of work just mentioned, handled 55,260 cu. yd. of dirt and rock at costs ranging from 3.6 cents to 5.2 cents and averaging 4.7 cents per yard, while a steam ditcher, working at some small washouts by digging into loose rock slides and hauling the material an average of three-fourths mile, handled 1,680 cu. yd. at a cost of 54 cents per yard. These costs included the expense of loading, unloading and moving the machines between various points.

On bank-widening work, draglines working along fills of moderate height can place dirt for approximately 3.6 cents per yard, while on high fills where they can reach about half way to the top, the material can be placed by building a road about half way up the side of the fill. The dragline then

works along the road, using the road material to complete the job. The cost of this work is 6 cents per yard. If the fill is too high to handle in this manner, a dragline or shovel and trucks can be used and the material placed for 11 cents per yard where the hauls do not exceed 1,000 ft.

A line change which involved a channel change, long hauls and part rock excavation was made on one railroad by using shovels, trucks and bulldozers, at a cost of approximately 30 cents per yard. Another railroad made a line change in mountain territory which consisted of lining a curve in 15 ft. to remove tracks from a slide. The face varied from 20 to 80 ft. in height and was composed of alternate layers of hard shale and rock, the layers being from 3 to 10 ft. in depth. A large bulldozer, a 1¼-yd. shovel, and four 4-yd. trucks were used, with an average haul of 700 ft., 17,000 cu. yd. of shale and rock were handled for 15½ cents per yard.

Crawler Tractors, With a Variety of Attachments, Are Taking Many Operations Off From the Tracks

Bulldozers are used economically in bank widening work when the height does not exceed 8 ft. On low fills up to 3 ft. high, the blade may be angled and dirt placed by plowing parallel to the track. For heights between 3 and 8 ft., bulldozers work at right angles to the track and shove the material directly in place. Large bulldozers working in desert territory widening banks ranging from 3 to 6 ft. high by widening the subgrade 4 ft. on a side, completed 9,000 to 11,500 ft. of bank per day on one side at a cost of less than 2 cents per yard. A crawler shovel loading air dump cars did the same type of work for approximately 15 cents per yard.

Rock and dirt slides can be cleared by the use of off-track equipment economically and in a fraction of the time required by on-track equipment. On one slide 500 ft. long and varying from 4 to 9 ft. in depth, a work train with a clamshell worked ten hours and made hardly noticeable progress; a large bulldozer was then started on the slide and the track was in operation six hours later.

In another instance, a cloudburst in a canyon caused 19 large wash-ins. Previous similar wash-ins in this territory had required 3 to 4 days to clear with work trains and ditchers working from each end. This time a 1¼-yd. crawler dragline, a 1¼-yd. crawler shovel and a bulldozer were placed on the job and track was in service in less than 24 hours. The principal saving effected by using off-track machinery was the expense of detouring trains several hundred miles which would have been necessary if old methods of clearing the slides had been used.

In a winter operation, a small bulldozer with a snow blade kept switch stands clear and the leads of a 13-track yard open during several severe snow storms, saving the time of eight laborers and several hours work train expense, handling snow plow during each storm.

### Front End Loaders

Crawler front end loaders are economical for cleaning ditches, provided the ditches are not too wet. One loader with a one-yard bucket, ditching cuts from 300 to 1,000 ft. long without interfering with train operation, handled 4,175 cu. yd. in one month for 4.6 cents per yard. If the cuts do not exceed 500 ft. in length, bulldozers may be used to shove the dirt from the ditches, the cost being approximately the same. Ditching in the same territory with work trains handling a steam ditcher formerly cost in excess of 50 cents per yard.

In May, 1941, two large bulldozers and two combination bulldozer front end loaders doing ditching and grading for new tracks and various other maintenance jobs, handled 26,210 cu. yd. of dirt and rock, at an average cost of 4.9 cents per cu. yd. This included the cost of loading, moving and unloading the machines when moving to different locations.

A few scrapers or carryalls are now being used by railroads, but little information is available as yet regarding the cost of work performed by them. Contractors have used these machines extensively for several years and on large grading jobs where earth excavation is handled and the hauling distance is not excessive, these machines are reported as being superior to others in most cases. The principal uses of these machines by the railroads are for grading for new lines, line changes, track extensions and yard extensions or additions.

Two crawler compressors, operating 16 tampers each and connected to them by 100 ft. of flexible hose, surfacing track in slag ballast territory with a maximum raise of 2 in., averaged 4,800 ft. per day while three track-type compressors with 2,000 ft. of metal air line, operating 32 tampers in the same territory, averaged 3,300 ft. per day.

A test was made for one week between an old model on-track compressor and a new crawler-type compressors, operating the same number of tampers under similar conditions and on adjoining territories. The gang handling the on-track compressor used 10 per cent of the total gang labor for moving the compressor and handling air lines. The crawler compressor gang used only 4 per cent of the total labor for handling the compressors and flexible air lines.

A Crawler Dragline in Bank-Widening Operations

### Motor Trucks

The use of trucks results in substantial savings for bridge and building and water service gangs, motor car and machine maintainers, scale inspectors and track gangs in some territories. The trucks haul men and materials economically within a 50-mile

radius, eliminating the hazards and delays of motor car operation, saving the expense of moving outfit cars at frequent intervals and allowing the men to be at home each night.

A cloudburst caused wash-ins on three branch lines. These wash-ins were about the same size and each required 15 men approximately one hour to clear them. A truck and one gang cleared the wash-ins and were on duty only 5½ hours. If gangs had used motor cars, the cost to clear the line would have been at least twice as great.

Truck or crawler cranes are much more economical for unloading or loading rail and other heavy material than on-track cranes as they may be moved along the cars or the cars may be pulled by them while an on-track crane requires switching for each two cars loaded or unloaded, unless an adjoining track is available.

When unloading rail for a large relay job, draglines of ½ to ¾ cu. yd. type are much more economical than on-track machines, provided the rail is loaded on flat cars or cars with drop ends as the machines proceed from car to car and an entire train can be unloaded without switching.

In territories where sidings are available and not more than five miles apart, especially on branch lines where the rail relaid is not heavier than 90 lb., rail cars are spotted on sidings or spurs, the rail is unloaded by a dragline and placed on heavy-duty push cars pulled by motor cars, and distributed. The dragline is then used for laying the rail, after which it loads the scrap rail on push cars which are hauled to spurs where the rail is piled for loading on cars. The usual saving by this method is the cost of a work train for approximately the same time that the dragline and push and motor cars are used in distributing and picking up the rail.

### Weed Mowers

Off-track weed mowers are much more economical in some territories than the on-track type, as the track mowers require a section foreman, two laborers and two flagmen and have frequent train delays, while the off-track machines work continuously and only two men are required. The off-track mower also mows station grounds, weeds and brush near road crossings where the view is obstructed, and in locations where noxious weeds are prevalent the entire right of way is mowed before the weeds go to seed and spread.

One or more railroads are now successfully using crawler cranes for laying rail. These machines are equipped with flanged wheels which are raised and lowered hydraulically. While definite information has not been received as to costs, as compared to track-type cranes, the off-track machines have certain definite advantages, as they can be taken off the track at any point, instead of having to go to the nearest siding, and at the close of the day's work they are removed from the track and are on the job ready to start the next day's work.

A Number of Types of Off-Track Tie Tamper Power Units Are Now Available

Committee—A. L. Kleine (chairman), div. engr., D. & R. G. W., Salt Lake City, Utah; C. J. Jaeschke (vice-chairman), div. engr., M. P., Little Rock, Ark.; M. R. Black, supv'r., L. & N., Etowah, Tenn.; E. J. Brown, dist. engr., C. B. & Q, Galesburg, Ill; A. L. Campbell, rdm., S. P, Alturas, Cal; M. H. Dick, eastern editor, *Railway Engineering and Maintenance*, New York; W. T. Elmes, rdm., P. & L. E., Pittsburgh, Pa.; W. O. Frame, supt., C. B. & Q., Centerville, Ia.; E. A. Gill, supv'r., Sou., Batesburg, S. C.; J. R. Hamilton, div. engr., D. S. S. & A., Marquette, Mich.; T. E. Meadows, supv'r., Sou., Emporia, Va.; A. G. Reese, engr. m. of w., C. & S., Denver, Colo.; F. E. Schaumburg, rdm., C. & N. W., West Chicago, Ill.; W. Smock, supv'r., Sou., Somerset, Ky.; H. L. Standridge, supv'r., C. R. I. & P., Little Rock, Ark.; G. E. Steward, rdm., S. P., Merced, Cal.; F. W. Tomlinson, Jr., transitman, Penna., New York; T. L. Williamson, rdm., S. P., Winnemucca, Nev.; W. C. Radford, supv'r., Sou., Chester, S. C.; W. L. D. Johnston, supv'r., Sou., Shelby, N. C.; and D. H. Whisler, asst. engr., Penna., Philadelphia, Pennsylvania.

## Discussion

Answering a question, Chairman Kleine explained that the costs given in the report include out-of-pocket expenses, such as wages, repairs and fuel, but do not include interest or depreciation. Explaining the manner in which crawler draglines are used on his road in unloading rail, he said that two such units, equipped with lift lines, are used in each instance, one being placed on a car at each end of the string of cars to be unloaded. The machines then work toward each other, each of them unloading rail on a given side of the track. Mr. Kleine emphasized that ingenuity must be used in developing ways in which off-track equipment can be employed in place of work trains. G. L. Sitton (Sou.) expressed the view that it is desirable to be conservative in discussing the savings that can be expected with off-track equipment.

Explaining the apparently high cost of operating work trains on his road in 1937, as given in the report, Mr. Kleine said that conditions are such that work trains must frequently be operated 16 hr. daily, thereby involving considerable overtime payments. In this connection, E. E. Crowley (D. & H.) pointed out that, since the figures on savings given in the report were compiled, conditions have changed in that the volume of traffic being handled by the railroads is substantially greater so that the importance of performing work with off-track equipment has increased.

Answering a question, Mr. Kleine stated that the economical limit of haulage, using front-end loaders, is about 800 ft. and that, where the length of haul is greater than this, trucks loaded by a power shovel or dragline would be more economical.

Answering a question put by Mr. Crowley regarding the recommended size of tie-tamping outfits for use with off-track power plants, Mr. Kleine recommended the use of 16-tool outfits. E. L. Banion (A. T. & S. F.) said that crawler compressors of both the 4-tool and 8-tool sizes are used on his road, and expressed the view that the 8-tool unit is very desirable for use with extra gangs. In view of the increasing importance of mechanization, C. C. Pelley (I. C.) suggested that it might be desirable to depreciate machines at a relatively rapid rate in order that they can be retired within a reasonable length of time and be replaced with newer and more modern equipment.

# Railroads Play Large Part in War Departments' Huge Construction Program

By COL. L. R. GROVES

Chief, Operations Branch,
Construction Division,
Office of the Quartermaster General

WHEN the present emergency was declared, there were certain vital essentials that had to be provided—increased man power, housing facilities, and enormous quantities of supplies, arms and ammunition. To the Construction division, Office of the Quartermaster General, fell the task of providing the housing as well as the ordnance facilities.

The over-all cost of the temporary emergency construction program for the fiscal year ending June 30, 1941, was in excess of $1,500,000,000. It included more than 450 projects at 250 different points, scattered from coast to coast, as well as operations in Puerto Rico, Hawaii and the Panama Canal zone. The general program undertaken was divided as follows:

Troop housing 332 projects—$880,000,000.

General hospitals, 9 projects—$21,000,000.

Ordnance facilities, 48 projects—$533,000,000.

Chemical warfare, 10 projects—$7,380,000.

Storage depots (other than ammunition and explosives), 26 projects—$73,000,000.

Miscellaneous, 38 projects—$19,000,000.

First and foremost on this program was the demand for troop housing, which called for providing shelter for 1,195,000 men by June 30, 1941. On that date, new construction was available for 1,214,000 men. This troop housing included 69 camps, cantonments and replacement training centers (with a capacity of 20,000 to 60,000 men each); 30 reception centers; 52 harbor defense projects; 16 air corps projects; 110 housing projects; and 38 miscellaneous projects.

## Speed Essential

But troop housing alone was not sufficient. Vast plants had to be constructed for the ordnance department if our rapidly-expanding army was to be armed. Work on these ordnance and other manufacturing plants was stepped up by means of extra shifts, and today ordnance equipment and ammunition are rolling out of these plants with constantly increasing momentum.

Col. L. R. Groves*

It can be readily seen from this program that the essential requirement was speed and more speed; without the facilities and efficiency of the railroads of the United States, this speed would have been impossible. Within the average construction project the railroad was a prime essential during construction activity, and the construction of railway lines was generally among the first work undertaken by the contractors. The railroad was used not only to move material but to transport the workers back and forth over the job.

So far in the present fiscal year, the construction of four additional major camps has been authorized, in addition to increases and enlargements in the present facilities. Also, 23 new ordnance plants have been authorized, as well as major additions to the old ones. The present estimated cost of the construction program has now reached a point above $2,000,000,000. As in the past, railroad transportation facilities will play a highly important part in this program.

In all of these projects, the Construction division has found occasion to build a large amount of railroad trackage. The various projects that were underway as of August 2, 1941, will require the construction of a total of 1,256 miles of railroad, most of which had been completed. This figure will be greatly increased by the new contracts, as the ordnance plants alone, completed or under way, will require 1,356 miles of tracks.

The railroads have been most cooperative in more ways than in the actual transportation of materials. As an example of their extra-curricular activities, there were instances, one at Fort Bragg, N.C., and another at Fort Dix, N.J., in which it was found that needed hospital facilities were available except for the heating plant which was as yet uncompleted. In each instance, a locomotive was rented for a nominal sum, and was used for furnishing the necessary steam for the hospital, thus making it habitable. The railroads have also aided in solving the housing problems in several instances by operating special commuter trains between cities and the project sites.

## Ravenna Ordnance Plant

The Ravenna ordnance plant, located at Ravenna, Ohio, on a plot of ground aggregating approximately 36 sq. mi., will, when completed, be the largest shell-loading plant in the United States. This plant is served by nearly 123 miles of railroad lines, distributed as follows:

| | |
|---|---|
| Manufacturing areas | 22 mi. |
| Storage areas | 38 mi. |
| Service tracks | 28 mi. |
| Connecting tracks and classification yards | 18 mi. |
| Storage depot | 12.55 mi. |
| Temporary construction | 4 mi. |

Controlling factors of railroad construction were set up by the War department as follows:

(1) Maximum grade—1 per cent compensated (later relaxed to permit 1.75 per cent grade).

(2) Maximum curvature—12 deg.

(3) Trackage throughout length of loading lines (approximately 4,000 ft.) to be level.

(4) In front of each storage building the track to be level to prevent cars from rolling, as derails were prohibited.

The alinement of the railroad plan was varied wherever possible to fit the terrain to best advantage, but building locations held us to definite locations at many points. Maximum grades were used frequently to keep excavation quantities to a minimum. This was desirable because the plant site is generally rolling, and even with a 1.75 per cent grade, cuts and fills as

*Photo by U. S. Signal Corps.

high as 20 ft. were required in places. Both excavation and fill slopes were made $1\frac{1}{2}$ to 1.

Creosoted crossties, 100-lb. A.R.A. relay rail, tie plates and 12 in. of slag ballast, were used in the track construction, the depth of ballast being increased to 15 in. in places where poor subgrade conditions were found.

### Solved Drainage Problems

The ground water was unusually high in the plant area and several swampy places were encountered. Side ditches along the tracks and outlet ditches were used to drain these low places, and produced a dry, stable subgrade. In deep cuts, pockets of very wet material were found, usually a blue clay that was comparable to quicksand. Here, a system of closed side drains across the subgrade, using perforated pipe backfilled with slag, dried out these pockets in a remarkably short period of time and produced a stable subgrade. French drains of crushed slag were placed through the track subgrade at regular intervals. Throughout the yard areas, these crushed slag drains were installed across the full width of the grade at intervals of about 50 ft. Culverts are mostly of reinforced concrete pipe, and, because of our inability to secure structural steel or reinforcing steel in a reasonably short period of time, multiple-pipe structures were used in streams having considerable drainage areas.

In spite of attempts made to locate the railway as much as possible in locations where subgrade and drainage conditions were favorable, this could not be done in all cases. In some areas, pockets of virtual quicksand were encountered. Here, piling was driven, making submerged trestles. In some areas, special side drainage was necessary to collect ground water and carry it to drainage ditches. Where this occurred adjacent to the track, clay tile and vitrified pipe, backfilled with slag, were used in the drainage system.

Due to peculiarities in the track layout and operating conditions, it was necessary to install a railroad signal system over a large part of the plant trackage to facilitate train and car movements. This system, equipped with semaphore light signals and motor-driven switches, is interlocked throughout and arranged for remote control. The system was designed by the Union Switch & Signal Co., and was installed by the contractor under our supervision.

During the first 11 months of construction, the Ravenna plant received by rail 7,500 cars of slag; 650 cars of lumber; 500 cars of steel; 155 cars of machinery; 365 cars of reinforcing steel; 700 cars of railroad ties; 450 cars of sand; 600 cars of brick; and 4,208 cars of miscellaneous material, making a total of 15,148 cars. This means that an average of 1,377 cars were received per month. When we consider that similar large quantities of material are required at all of our defense projects, it is easy to visualize the magnitude and importance of the part that the railroads are playing in our national defense program.

# Recent Developments in the Renewal of Ties

**Report of Committee**

DURING the last 15 years, annual tie renewals on the railroads of the United States have decreased nearly 50 per cent. This noteworthy reduction has been brought about in part through improved protection against mechanical wear, better selection of tie materials, improved inspection standards and the preservative treatment of tie timber—the latter, in-so-far as increased tie life is concerned, being by far the most important. In addition, better ballast and drainage conditions, and more careful inspection of those ties to be renewed have also had influence in producing greater service from track ties. Regardless of the enormous reduction in annual renewals required, the cost of cross and switch ties, plus the labor required for their installation, is still the largest single item of roadway maintenance expense on most railroads.

Tie renewals have been a matter of keen and earnest discussion for more years than most of us can remember. During the last three or four years especially, a large number of articles, addresses and letters bearing upon this subject have been published. One of the most informative of these was the address by H. R. Clarke, engineer maintenance of way of the Chicago, Burlington & Quincy, before this convention last year.

F. G. Campbell
*Chairman*

In covering its assignment, your committee feels that it should report facts relative to the subject, rather than attempt to set up recommended practices. Therefore, it has briefly summarized much that has been said and written before, and has presented some of these facts in a different light, with the hope that its efforts will be of some service.

### Renewing Switch Ties

There has been much discussion in the past relative to the relative advantages and disadvantages of spot and out-of-face renewals of both cross and switch ties. At one time untreated white oak was used generally for switch ties. White oak is highy resistant to spike cutting and other mechancal wear, and the service life of the individual ties was unusually fairly uniform. It was the usual practice to renew white oak switch ties out of face—that is, a complete set at one time, since generally nearly all of the ties in the set reached the end of their service life at about the same time.

At the present time, however, creosote-treated red oak and soft woods have replaced white oak almost altogether as switch tie timber. These woods are more susceptible to mechanical wear than white oak and the length of their service life appears to be more variable. As a result, it is the usual practice at the present time

to make spot renewals of switch ties, renewing only such individual ties as have reached the end of their useful service. The turning or cutting of switch ties which have become badly spike cut, but which are otherwise sound, is also common practice at the present time.

### Spot vs. Out-of-Face Renewal of Crossties

There is a considerable difference of opinion among maintenance of way officers as to the relative advantages and disadvantages of spot and out-of-face renewals of crossties. Some advocate the spot renewal of crossties as and when the individual ties reach the end of their useful service life, and, on sections of track which are being resurfaced, would remove only such ties as have less than one or two years service life remaining. By this method, practically the maximum service life is obtained from all crossties. It follows that the advocates of this practice generally contend that the need for resurfacing should be entirely independent of the necessity for tie renewals, and should be done only when required for other reasons. It is generally conceded, of course, that when tie conditions become extremely bad and a very large percentage of the ties have to be renewed at one time, the need for resurfacing is also indicated.

Two common objections to the all, or nearly all, spot renewal of ties are, first the unequal bearing produced between the old ties and the new ties that are spotted in, which sometimes results in rough track, continuing to the time when the new ties, through general maintenance, can be tamped to an equal bearing, and second, the added cost of spot renewal over that of renewals carried out during resurfacing operations. The latter objection, if sufficient accurate cost data were available, should be susceptible to economic evaluation. Unfortunately, most railroads are sadly lacking in usable data on the cost of tie renewals, as well as on the cost of most other maintenance operations.

The Chesapeake & Ohio, however, has developed considerable information on the relative number of man-hours required for digging in ties in stone and gravel ballast as compared with the man-hours required for spot renewals in similar ballast when giving the track a raise of two inches. These data indicate that it costs approximately 16 cents per tie less to renew ties in rock ballast while raising track. In gravel ballast, the cost on the same basis is approximately 21 cents per tie less. Assuming an average life of tie of 25 years, the value of each year of service life of a creosoted crosstie will usually be from 10 to 12 cents. It would appear, therefore, that the sacrifice of more than two years' service life of a tie for the sake of the lower installation cost obtained while renewing when surfacing, is questionable. Also, the tendency of foremen and others, when track is being raised, to be somewhat pessimistic about the remaining service life in a tie which they think should be removed, should not be overlooked.

Some maintenance officers advocate the renewal of ties during the process of raising and resurfacing track so that the necessity of making spot renewals by digging in is practically eliminated. This practice can be accomplished in several ways. One of these is by the deferment, in-so-far as possible, of the renewal of ties which have reached the end of their service life until such time as resurfacing operations become necessary for other reasons. This, obviously, for a period of time, throws the load carried originally by an expired tie upon the adjacent ties. In these times of heavy traffic and high speeds, this practice is not generally considered advisable and is probably not followed to any extent except on lines that carry light and slow traffic.

A second method is to make resurfacing operations almost entirely dependent upon the renewal requirements; that is, if more than a certain number of ties per rail have to be renewed, resurfacing will be undertaken regardless of other conditions. The economies of this method also should be susceptible to mathematical determination, provided sufficient cost data are available. These economies, of course, will depend upon the amount saved by renewing ties while resurfacing, as compared with digging in a similar number of ties. This saving will be offset by the added cost of surfacing, which should be adjusted to take into account the amount of time which would elapse before the track would have to be resurfaced because of conditions other than required tie renewals. Some spot renewals of ties will, of necessity, be required if either of the two methods outlined is followed; however, there is no question but that, with either, the number of spot renewals would be reduced very materially.

A third method of making tie renewals while surfacing is to carry out periodic resurfacing operations over all main tracks of the system every three to five years. At the time this resurfacing is done, all ties are removed which cannot be expected to last until the next regular resurfacing is scheduled. This method, unquestionably, makes the necessity for spot renewals in main tracks practically nil. It also probably results in exceptionally well maintained track. The most serious objection to this method is the possibility of added cost, this added cost being brought about through the sacrifice of useful tie life and through the incurrence of surfacing costs in advance of when such surfacing is necessary for reasons other than tie renewals. On the other hand, this method may result in appreciable reductions in general maintenance costs. Outright condemnation of any method of tie renewals for purely economic reasons should be reserved until we are possessed of more factual cost data than are now generally available.

### Section vs. Specialized Gangs

Whether tie renewals should be made almost entirely by small section gangs, or whether, in-so-far as possible, such renewals should be made by larger specialized gangs, leaving to the section gangs only incidental renewals which would be more expensive to handle by the larger gangs, has become a question of controversial discussion. It seems to be conceded generally, at least in-so-far as opinion is concerned, that, given a sufficient density of renewals, say more than 100 to 150 per mile, the larger specialized gangs will renew ties more cheaply than section gangs. These economies are brought about largely through the reduction in supervision overhead, and in the specialization of work.

With the specialized gang assigned to the work of tie renewals alone, one man or a group of men can be assigned to the same task for several weeks, or even for the entire season. The men can be selected in accordance with their adaptability to certain operations, and through their continued practice in a given task can, undoubtedly, become much more proficient in it than can section men who, of necessity, must change from one type of work to another almost constantly. The most serious objection which is then raised to specialized gangs is with regard to the quality of the results that are produced. It is said by some that the motivating interest of those in charge of these gangs is production, and that they, therefore, are inclined to slight the work, leaving behind much additional work for the section gangs to do. Others contend, and it appears with reason, that this is merely a matter of supervision, and that, given proper supervision, the large specialized gangs will do just as good work and, in some cases, even better work than that done by section gangs.

At the present time, most tie renewals in connection with resurfacing operations are made by specialized or extra gangs. Other work besides that of actually renewing the ties is probably often the controlling factor in this. With certain notable exceptions, most spot renewals are and have been made by section gangs. The use of specialized gangs in the spot renewal of crossties will be discussed later in this report.

Probably the decision as to whether to use specialized gangs in tie renewals does and should depend almost entirely upon local conditions. These conditions may include length of season, kind of ballast, volume of traffic, availability of local labor, and density of tie renewals. The last is probably the most important. It appears that during the last few years the trend has been towards the specialized gang; however, with the continued reduction in density of tie renewals, brought about through the use of treated ties and other improved conditions, as already pointed out, this trend in the future may swing back toward the small section gang.

### Mechanical Aids for Renewals

Probably the most interesting phase of the subject we are now discussing is the various machines which have been developed to aid in the work of tie renewals. The reason why this has not been mentioned previously is that, while some use is now being made of such machines, practically all tie renewals are still being made by purely hand methods. The importance of these machines, therefore, is not in their present use, but rather in the possibility of their future development. While unsuccessful experiments were made with tie pulling machines as much as 25 years ago, the major development in tie pullers, as well as in other machines used in connection with tie renewals, has been within the last three or four years. So far as your committee can determine, the machines which are now used in making tie renewals consist of tie pullers, tie saws and tie-bed shapers. Four types of tie pullers have been placed on the market within recent years.

### Tie Pullers

One type consists essentially of a rectangular steel bar which, when in use, connects with the ball of each rail and extends between the rails; a pair of jaws which grip the ties; and a lever arm for actuating the jaws. The steel bar is made in two parts, connected by a wooden block or splice fitted inside the rectangular bar to provide insulation between the rails. The pair of jaws which grip the tie are fitted to the lever arm, which is connected to the crossbar. The lever arm contains a socket to which a standard lining bar can be applied for operating the tie puller.

The tie is pulled with a jacking motion of the lining bar, with the operator standing on the tie which is being removed. Forward motion of the bar releases the jaws and automatically sets them back close to the rail. A pulling motion, on the other hand, forces the jaws to grip the tie tightly and, in addition, moves the tie the distance allowed by the lever arm. The operation is continuous and the puller does not have to be reset. Before the tie is removed, spikes must be pulled and tie plates removed, except that in the case of single shoulder tie plates, the tie plates on the leaving end of the tie may remain in place. This tie puller weighs about 54 lbs. and is relatively inexpensive. For this reason, it is adaptable for use with a small section gang.

This tie puller was developed on the Alton some time before it was placed on the market and has been used on that road for a number of years. A test was made last year on the Elgin, Joliet & Eastern, and ten of them are now in use on that road.

A second type of tie puller consists of gripping jaws attached to a horizontal ratchet jack. When in use, this puller sets entirely on the end of the tie outside of the rail. The jack bears against the web of the rail and is operated by a lever with a lining bar. This puller has to be reset each time the full length of the ratchet jack has been reached. Three resettings are usually required on an ordinary crosstie. When the lining bar is removed, the unit is always in the clear of traffic. It weighs about 80 lb. and is relatively inexpensive. The Southern Pacific Lines in Texas and Louisiana have used this type of tie puller rather extensively in renewing crossties, in turning switch ties and in other types of track work.

A third type of tie puller consists essentially of two cables which are wound on capstans. In operation, this puller is placed on top of the tie outside of the rails and works against the adjacent rail. The cables are extended under the rails to the opposite end of the tie where they are connected to a plate which has bearing on the end of the tie. To remove the tie, the cables are then wound on the capstans by a lever and ratchet. This puller has two speeds and develops great power. It weighs somewhat in excess of 100 lb.

Still another type of tie puller consists of a heavy spike-studded bull wheel operated by a lever and ratchet, all of which is mounted in a heavy cast steel frame. It has both a high-speed and a low-speed operating lever. The low-speed lever develops considerable power and is used to start the tie in motion. After the tie has been loosened from its bed, it can usually be moved considerably more rapidly with the high-speed lever. In operation, this puller is placed on one end of the tie outside of the rail and heavy jaws engage the base of the rail. The operator stands on the tie and, by means of the lever, turns the bull wheel and forces its spikes into the tie to be removed. This tie puller weighs more than 200 lb. When it is being moved, it can be pulled back toward the center of the track until two rollers rest upon the head of the rail. It can then be moved along the rail to the next tie that is to be removed.

An inherent disadvantage in all types of tie pullers yet developed is that they will not pull a tie which has been considerably rail or plate cut unless, before pulling, the tie is adzed to the base of the rail. Also in the use of most types of tie pullers, care must be taken in pulling the tie to avoid raising, or cocking, the rail. This is especially true if the tie which is to be pulled is under rail of 100 lb. section, or lighter. Also, if a tie pulls especially hard, and the rail is light, the track may, in some instances, be thrown out of line. In view of these facts, it must be conceded that the perfect tie puller has not yet been developed; however, it is believed that those now available

A Large Specialized Gang Renewing Ties Ahead of Out-of-Face Surfacing work

are worthy of consideration and can, under certain conditions, probably be used to advantage.

### Tie Saws

The tie saw is a power machine which operates on the track and cuts the ties just inside the rail. It has a pressed steel frame on which the saw, and a gasoline motor by which it is powered, are mounted. The saw itself is a long tapered vertical steel blade, oscillating parallel to the rail, the cutting stroke of which can be adjusted to any width of tie. A saw sharpener is also mounted on the frame.

The tie which is to be removed is cut into three pieces. The saw first makes a cut on the inside of one rail just clear of the tie plate, and is then turned to make a similar cut adjacent to the other rail. In practice, a large number of ties are first cut along one rail, and the machine is then turned to make the final cut in the same ties. The entire machine weighs less than 300 lb. and is so constructed that it can be removed from the track easily by two men.

There is no question but that the tie saw is a useful machine, but like most other labor-saving machinery, the actual savings which can be effected depend largely on local conditions. Where renewals are largely in groups and adjacent renewals occur with considerable regularity, there is probably little economy in the use of this machine. However, where renewals generally occur singly and are not too widely spaced, its use has been found to be very advantageous. Where the ballast cements or where there is a heavy growth of grass or other vegetation having heavy root structures, or where the climate is extremely dry and the digging correspondingly hard, the value of the saw is probably enhanced. Under certain conditions, savings of as much as one-third have been made in spot renewals of ties.

The use of the tie saw precludes any "second guesses." The tie spotter must be absolutely certain that the tie is ready for renewal, for there is no chance to rectify an error by reinsertion of a tie which, upon exposure, appears to possess further useful life. Also, in some territories, full-length second-hand ties have a sale value for use for posts and other purposes. The loss of such income must be balanced against the savings accrued through the use of the saw.

Because of its large output, the tie saw is probably better adaptable to the use of specialized gangs than to use by ordinary section gangs. The Great Northern has used tie saws extensively with specialized gangs making spot renewals of ties. In 1938, this road had 32 tie saws in service, and since that time has added additional machines. Under the plan of operation on the Great Northern, the saw is operated in two eight-hour shifts by a gang sufficiently large to keep renewals closely behind the sawing operation. With this plan, it is necessary to permit ties with one cut through them to remain in the track over night. This single cut is made after the forces making renewals have stopped work for the day. When the gang starts again the next morning, the saw works immediately ahead of it making the second cut, which leaves the ties in three sections ready to be removed from the track.

For these highly specialized gangs working on the Great Northern, a special technic has been developed for both the removal of the old ties and the insertion of the new, which can probably be described best by indicating the make-up of a typical gang (one foreman and seventeen men), together with the tasks regularly assigned to the men in the gang.

The typical gang consists of two saw operators (one for each shift of the machine); two men (one for each shift of the machine) cupping out holes alongside the ties to be removed, to protect the saw from being dulled by contact with the ballast, (this is done with a special tool furnished with the saw); one man with a claw bar, who pulls spikes and assists in lifting out the old ties; two men, with a broad-pointed chisel bar to bar out the cut ends of the old ties, who remove and load the pieces on a push car for disposal; six men, working in pairs with shovels and tie tongs, cleaning out the old tie troughs and pulling in and tamping up the new ties. (In this operation, a minimum of disturbance is made to the old tie bed, it being necessary only to cut it down sufficiently to permit the insertion of the new tie, which is generally thicker than the tie which has been removed. The amount of ballast removed from the old trough which has to be shoveled back is, therefore, quite small). One man with a special two-pronged pinch bar springs up the rail and inserts the tie plates on the new ties. Two men are then required for gaging and spiking the new ties, and, finally, one man to do such redressing of the ballast shoulder and of the ballast between the rails as may be necessary.

In addition to the Great Northern, your committee is informed that these saws are now being used to some extent on the Burlington, the New Haven, the Milwaukee, the Union Pacific, and several other roads.

### Tie-Bed Shapers

A unique machine known as a tie-bed shaper has been developed on the Union Pacific. Its manufacture has been entirely by the forces of that road, and we are informed that they have built from 20 to 25 of these machines. The machine consists of a rotary ballast cutter-head powered by a gasoline engine and mounted on a light track car. Horizontal transverse beams provide for horizontal movement of the assembly over the full length of the tie. The cutterhead, mounted at the bottom of a vertical shaft, is so placed that in working position it overhangs the front end of the car. The frame of the cutter is hinged to the car so that it can be tilted backwards to raise the cutter-head over the rail. The cutter-head is 14 in. in diameter and operates at about 900 r.p.m.

The machine is used after the old tie has been removed, preferably without cleaning the ballast from the adjacent cribs. Ties which are to be inserted are carefully measured and the machine is set to correspond to the measured thickness of the new tie. This makes it unnecessary to tamp

On Many Roads, Most Replacement Ties Are Spotted In by the Section Forces

the new ties. The machine is sufficiently light and compact that it can be removed from the track quickly by four men. Therefore, in its operation, no slow orders are issued.

This machine is adapted peculiarly for use in ballast such as disintegrated granite. This ballast tends to pulverize under traffic and repeated tamping, and to puddle and cement so as to form an almost impervious bed beneath the ties. It follows that hand-deepening of such cemented tie beds is very expensive, which has contributed to the advantages of mechanically loosening and partially removing such cemented material to a uniform and carefully determined depth.

**Evolution of Methods on the Union Pacific**

It seems appropriate in this report to include a brief review of the progress which has been made in tie renewal methods on the Union Pacific, which feature the use of specialized gangs. This progress has been evolutionary in character since each step therein seems to have brought on another. Its inception was in 1930 when numerous complaints were received from section laborers because of the difficulty in handling creosoted ties. For this reason, special gangs were organized to unload and distribute ties only. The special gangs for unloading were so satisfactory that the idea of specialized gangs for renewing ties was conceived, and such gangs were used to a limited extent in 1932. The use of these specialized renewal gangs was extended from year to year until 1934, and from that time until last year were used over the entire system.

As first organized, these specialized tie renewal gangs were equipped with only ordinary hand tools and their work was confined almost solely to tie renewals. Ordinarily, they did no surfacing, the exception being only where extra heavy renewals were required, which would result in uneven surface. These specialized gangs, using only ordinary hand tools, inserted from 11 to 12 ties per man per eight-hour day in tracks ballasted with disintegrated granite. On branch lines, ballasted with cinders, they inserted from 13 to 14 ties per day. This compares with about 8 ties per man per eight-hour day when the work was done by section gangs.

In 1937, experiments were made with the tie-bed shaper previously described. These experiments were so satisfactory that five of these shapers were used in regular service through the season of 1938, being assigned to the specialized tie gangs. The gangs using the tie-bed shapers were increased from 24 to 28 men. One of these gangs, working from June to October, 1938, renewed more than 46,000 ties at an average rate of more than 16 ties per man per eight-hour day, at a cost of 22.9 cents per tie. Ten additional tie-bed shapers were placed in service in 1939.

In 1939, tie saws were added to some of the 28-man gangs. In June, 1940, one of these gangs equipped with a tie saw and a tie-bed shaper, inserted 7,873 ties in 18 working days, or an average of about 15½ ties per man per eight-hour day at a cost of 26.6 cents per tie. While this cost is slightly more than that attained by similar gangs with a tie-bed shaper alone, the increased cost was probably brought about entirely by decreased density in tie renewals. This is indicated by the fact that during the same period another gang of the same size, but without machines, inserted only 5,317 ties, or an average of about 10½ ties per man per eight-hour day. Not only did the tie saw probably reduce renewal costs, but was also very advantageous in that it permitted the removal of the old ties without digging out the adjacent crib, creating a condition much more satisfactory to the work of the tie-bed shaper.

In the work of these mechanized tie gangs, special emphasis has been placed on not disturbing the old tie bed. Marked success has been achieved in this respect, although occasionally a new tie will require additional tamping after several weeks.

From the foregoing, we must conclude that at the present time the progress in the art of tie renewals has not kept pace with the marked improvement in tie material. This in-no-wise means that improvements in the art have been negligible; nor does it mean that sincere effort and thought, especially in the last decade, have not been given to the development of more economical and better methods of making tie renewals. During this period, sincere effort has been made to accomplish tie renewals with the least detrimental effect on the general track structure, and much has been accomplished toward that end.

We must also acknowledge that mechanical aids in tie renewal work are still in the experimental stage and lag far behind the state of development which has been reached in such aids to other phases of track and roadway maintenance. With the trend towards a diminishing density of tie renewals on most roads and the consequent trend to throw such renewals back to the small section gang, the present need appears to be for the development of tie renewal equipment light enough and inexpensive enough to be adapted physically and economically to use by such gangs. However, as the large number of treated ties which have been inserted during the last 10 to 15 years begin to reach the end of their service life, cycles of heavier renewals are bound to occur, and there is, therefore, a fertile field for the development of machines to be used with larger specialized gangs.

Committee—F. G. Campbell (chairman), asst. ch. engr., E. J. & E., Joliet, Ill.; W. A. Gunderson (vice-chairman), dist. main. engr., C. R. I. & P., El Reno, Okla.; N. F. Alberts, gen'l for., C. M. St. P. & P., Chicago, Ill.; P. Chicoine, rdm., C. P. R., Vaudreuil, Que.; H. F. Elliott, rdm., S. P., Ogden, Utah; J. W. Fulmer, asst. engr., Sou., Washington, D.C.; G. J. Giles, supvr., L. & N., Harlan, Ky.; J. D. Henley, supvr., Sou., Keysville, Va.; A. B. Hillman, engr. m. w., C. & W. I., Belt Railway of Chicago, Chicago; N. D. Howard, managing editor, *Railway Engineering and Maintenance*, Chicago; R. S. Kniffen, gen'l rdm., G. N., Duluth, Minn.; N. B. Lewis, supvr., Sou., Keysville, Va.; H. P. Mason, supvr., B. & M., Boston, Mass.; Wm. O'Brien, supvr., P. M., Toledo, Ohio; E. L. Potarf, asst. supt., C. B. & Q., Sterling, Colo.; W. H. Sparks, gen'l track insp., C. & O., Russell, Ky.; J. S. Vreeland, associate editor, *Railway Engineering and Maintenance*, Chicago.

## Discussion

A Chinn (Alton) referred to the term "out-of-face" as used in the report in connection with tie renewals, and inquired whether the committee meant to convey by this term its literal meaning. Chairman Campbell explained that, as used in the report, the term refers to renewals made in connection with out-of-face surfacing work, as distinguished from spot renewals. Mr. Chinn expressed the view that it is not practicable to renew 100 per cent of the ties at any given time, in view of the loss of service life from many of the ties that would be taken out, and was supported in this view by Chairman Campbell.

W. H. Sparks (C. & O.) expressed doubt that it is possible to install ties on the old tie bed without tamping them. He explained that new ties are installed on his road by the spot-renewal method and that all ties are taken out that will not last more than two years. In connection with this company's 1941 tie-renewal program, he said it was estimated that it would cost 54 cents per tie to dig in ties in stone ballast, while the cost to insert them in connection with surfacing work would be 29.2 cents—these costs including the unloading and installing of the new ties and the burning of the old ties.

Explaining the tie-renewal practice on his road, T. Mika (G.N.) said that the tie cutter is used in connection with the spot-renewal method,

employing specialized gangs. All tie renewals, he said, are made in advance of track surfacing gangs. As a result of a test that was made to determine the economy involved in using the tie cutter, he said that a test gang, when equipped with the cutter, inserted ties at a saving of about five to six cents per tie, as compared with the cost of doing the work without the tie cutter.

Turning to the question of tie pullers, Mr. Chinn said that, as a result of tests conducted on his road, it was found that the tie puller that had been developed on the Alton gave the best performance. These tests, he said, showed that a gang equipped with this tie puller can install 20 to 25 per cent more ties than if they are pulled out and in by hand.

# Gravel Ballast—Its Requirements and Preparation

**Report of Committee**

E. J. Brown
*Chairman*

TRACK is composed of three principal parts: the rail, on which the trains run; the ties, which hold the rails to gage and distribute the load from them to the ballast; and the ballast, which holds the ties in line and surface and distributes the load from the rails, through the ties, over the roadbed.

In the early days of railroading, the ties were laid directly on the subgrade, a certain amount of dirt being shoveled around and between the ties to hold them in position. As train speeds and axle loads increased, it became apparent that ballast was important to a good track structure—that "mud ballast" was not economical—and search was made for suitable ballast materials. As the volume of ballast is large when compared with the other components of the track structure, hauling it from its point of origin to the point of use and distributing it, form a large part of its total cost. Hence, one of the first considerations in selecting ballast is that the point of origin be not too far from the point of use, and that it be easily handled.

## Functions and Qualifications

The functions of ballast are: (1) to provide a firm and even bearing for the ties and to distribute the pressure from them as widely as possible over the roadbed; (2) to keep the track structure drained to prevent "puddling" or "pumping" track—also to prevent freezing in cold weather, both to eliminate heaving track and to permit necessary surfacing; (3) to fill the cribs between the ties, to hold them in place laterally, and to provide bearing for the ends of the ties, to hold them, and thus the entire track structure, in line; (4) to keep down the growth of vegetation within the limits of the track; and (5) through the drainage which it affords, to prolong the life of the ties.

To perform these functions in the most satisfactory manner, ballast must have certain qualifications. In the first place, it must be of fairly uniform size. It must not have particles larger than the desired maximum size, as such large particles make surfacing difficult and more costly. It must not contain too large a percentage of fine particles, as they fill the voids, preventing quick drainage of water falling on the track. It must have sufficient stability, or locking action, to prevent the shifting of the ties, and track, under traffic, but still be readily workable to simplify renewing ties or surfacing. It should disintegrate a minimum on exposure to the elements, should resist freezing and thawing action, and should not change consistency when wet. Furthermore, it must be hard enough to resist disintegration and breakage under the mechanical wear of surfacing and lining track, and the wave motion of the rail and ties which occurs under traffic.

## Availability a Factor

While crushed, washed and screened hard rock, such as trap rock or granite, best meets these requirements, such rock is found only in a limited number of areas, is expensive to prepare and handle, and thus cannot be used economically for ballast in many sections of the country. Local availability at low cost has, therefore, resulted in the use of a wide variety of other rock and materials, such as crushed limestone, gravel, chatts, decomposed granite, blast furnace slag, oyster shells, engine cinders, and other substances.

The one material which is available at more locations in suitable quantities and grades than any other is gravel. It is easily obtained from natural deposits, can frequently be used without preparation, and can be unloaded and handled in the track with a minimum of expense. Hence it is used more extensively for ballast than any other material.

Gravel is defined by the American Railway Engineering Association as: "The coarse, granular material, larger than sand, resulting from the natural erosion of rock." The erosion referred to was caused by the grinding action of the movement of the Ice Age glaciers that once covered much of the United States; by the mighty rivers created by the melting of those glaciers; by natural rivers; and by ocean tides and wave action in the many parts of this country that were at one time or another sea beaches or off-shore sea benches. This ice and water action broke up rock of varying composition, ground it down to varying sizes and deposited it in beds, often in thickness up to several hundred feet.

The composition of the gravel particles in different deposits varies greatly, depending upon the rock from which they were originally formed. The size of the particles found in these deposits ranges from fine sand to large boulders, depending upon the amount of erosive action to which they were subjected and the hardness of the material eroded. Some gravel beds are remarkably uniform in size of particles, while others contain a wide

range of sizes. Some contain much clay, silt and other impurities, either in layers or mixed with the gravel.

**Hardness Classification**

Rocks are classified for hardness in accordance with what is known as the Mohs scale. This scale groups rocks in 10 classifications of hardness, each of which can be scratched by the next higher classification, from the softest, talc, which is No. 1 on the scale, to the hardest, diamond, which is No. 10 on the scale.

If rocks of varying degrees of hardness are mixed together and subjected to continuous mechanical action, the harder rocks will survive, and the softer material, through wear, will disintegrate and eventually be reduced to dust. Gravel formed by the glaciers seldom contains much material of 1, 2 and 3 hardness, as the mechanical action of the ice pulverized all but the harder rocks. On the other hand, gravel deposited in stream beds frequently contains a large percentage of the softer stones, such as sandstone and limestone, due to the easier mechanical action on the stone forming the gravel. Channel gravel usually contains some silt, whereas glaciated gravel is usually fairly free of it.

**Selection of Gravel for Ballast**

In selecting a gravel deposit from which to secure ballast, the one within the economical range of haul which contains particles of the highest average hardness according to Mohs scale, without too great a spread in hardness, and with a minimum of Hardness 5; and furthermore, with a minimum of impurities, such as clay, silt, etc., should be given preference. It is also desirable that the particles be irregular in shape and relatively uniform in size, with the largest not more than two inches, particularly if the gravel is to be used without preparation.

It is obvious that if the deposit contains particles with a hardness range of 2 to 4, as well as of 5 to 7, the harder particles will break up and pulverize the softer ones under the mechanical wear of surfacing track and the wave motion of the ties under train movement, causing the ballast to retain water. This water, mixing with the finer materials, creates a mud of much the consistency of cement mortar, resulting in puddled track and a foul ballast that absorbs wind and train-borne dust as well as organic matter in the form of dried vegetation. The harder the particles and the more nearly they are of a uniform hardness, the better the ballast will resist mechanical wear and the longer will be its life.

Gravel of such desirable consistency, hardness, size and freedom from impurities will be found more often in glacial deposits than in other types. Such deposits are found north of the 39th parallel of latitude, which is approximately a line through Washington, D. C., Cincinnati, Ohio, St. Louis, Mo.; and Pikes Peak, Colo. This marks the southern boundary of the great Ice Age glaciers which once covered the northern part of the world. Of course, not all deposits north of the 39th parallel are good glacier-formed ones, and, on the other hand, good water-formed deposits are found south of it. Oddly as it may seem, a very poor deposit may be found only a few miles from a very good one.

The accessibility to deposits by means of existing trackage is important, as are also their thickness and area. This is to avoid too high a cost for track facilities for loading and to insure a sufficiently large total tonnage and possible daily volume over which to spread the cost of excavating and loading, and, if necessary, preparation equipment, to make the investment cost per ton economical. In many locations the demand for suitable gravel for concrete, particularly for highway work, has brought about the development of commercial gravel plants producing a grade suitable for railroad ballast. In the early days of railroading, all roads operated their own gravel pits. Now, many of them depend entirely, or in part, on production from commercial plants.

Too much emphasis cannot be placed on securing a gravel of uniformly hard consistency, with a minimum of silt and other impurities. The higher the wheel loads, gross ton miles and speed over the track involved, the more important it is to have a uniformly hard ballast. Once the gravel is unloaded in the track, there is little the roadmaster can do but to live with it. We all know the sad results when we get a stretch of track ballasted with gravel that is too soft or dirty—muddy, weedy track, poor surface and complaints, and with nothing that we can do except struggle along with it until it can be stripped out and reballasted. This must be watched especially when buying commercial gravel. From the trackman's standpoint, it is poor economy to accept an inferior ballast for any reason.

Freshly Spread Prepared Gravel, Ready for the Final Lift in a Grade Change Project

**Pit-Run Gravel**

Originally, all gravel ballast was used just as it came from the deposit. Such gravel is known as pit run. If pit-run gravel contains a minimum of clay, silt and other impurities, and the maximum size of particles is not too large, it makes good ballast for light-traffic lines. Much pit-run gravel is still used for ballast. For example, one road with approximately 4,000 miles of lines has developed approximately 40 gravel pits, many of which are productive of a satisfactory ballast without any special preparation.

The current specifications of the A.R.E.A. for pit-run gravel ballast, adopted in 1936, call for two classifications—Grade A and Grade B—in accordance with the following gradations:

| Sieve Size (Square Openings) | Amounts Finer Than Each Size. Per Cents by Weight Grade A | Grade B |
|---|---|---|
| 2½ In. | 97 to 100 | 97 to 100 |
| No. 4 | 20 to 55 | 20 to 65 |
| No. 200 | 0 to 2 | 0 to 3 |

To meet the widely varying conditions as to gradation found in gravel pits over the country, the foregoing grades are rather broad, and, as a result, many roads have found it desirable to adjust these specifications

to meet conditions on their respective lines, and, in fact, as regards different pits. For example, one road, through its specifications, seeks a pit-run gravel of maximum size of two inches, in which from 50 to 70 per cent will pass a No. 4 screen, but of which not more than 20 to 30 per cent will pass a No. 20 screen. As compared with the A.R.E.A. specifications, this road calls for a smaller maximum size of stone; permits a larger percentage of sand (smaller than ¼ in.); but limits the volume of extremely fine sand permitted by the requirement that not more than 20 to 30 per cent shall pass a No. 20 screen.

### Excess Silt Objectionable

Pit-run gravel containing large quantites of silt is not satisfactory for ballast, since the silt washes out of the gravel and accumulates around the ties, where it holds water and causes pumping, muddy track, with break down of surface and alinement. If the gravel contains particles larger than two inches, the cost of working the track will be increased.

Entirely aside from its effect on track maintenance, excess silt in ballast is highly objectionable to the operation of high-speed passenger trains. This is because of the dust created, which gets into equipment bearings and increases equipment maintenance, and which is objectionable to passengers, even to some extent where air-conditioned equipment is employed.

### Washed and Screened Gravel

To overcome the objections of silt and large particles, pit-run gravel can be prepared for ballast by washing to remove silt, and by screening to remove the larger particles, using only that gravel which passes through the largest screen size adopted. This leaves all of the sand in the gravel.

As already pointed out, one of the requirements of good ballast is that it quickly drains water away from the track. To obtain best drainage would require that the ballast have a considerable percentage of voids between particles. This has been proved by tests to obtain the best material to backfill around perforated drain pipes, in which it has been demonstrated that washed, pit-run gravel, with all particles removed that would pass through a ¼-in. screen, was by far the best. Strictly speaking, this is pure gravel, since, by A.R.E.A. definition, particles smaller than ¼ in. in size are sand. Such gravel, free from sand, has been used for ballast, but without complete success. The particles, lacking in sand to bind them together, or any crushed angular pieces to lock them together, tend to roll under traffic, making it difficult to hold the track in alinement. Such gravel also tends to seek a very flat slope, and hence the ballast shoulder does not hold up at the ends of the ties. Furthermore, such gravel offers insufficient resistance to the side pressure on ties created by rail anti-creepers, bunching up in the cribs under the force of the ties and allowing the entire track structure to move longitudinally, defeating the purpose of rail anchorage. This type of prepared gravel ballast has been aptly described by trackmen as "ball bearing ballast."

### Sand Separates

Such gravel, with some sand returned to it after washing, but with too small a percentage to bind the particles together and to prevent shifting of the track under traffic, is only partially successful. Furthermore, under the vibration of traffic, the coarser material separates from the sand and bunches around the ties, while the finer material moves beneath and away from the ties. The voids in the coarse material left immediately adjacent to the ties are in time filled with train and wind-blown dirt and organic matter, creating a condition similar to that produced by powdered crushed rock. Water is held around the ties, the track puddles, and the surface breaks down.

Until recent studies, it seemed to be the accepted opinion that muddy track was caused by pumping action, which pulled the mud up from the subgrade. However, in these studies, sections observed along the ends of ties through muddy stretches, in all cases showed clean ballast below the mud line, which stopped from one and two inches below the bottoms of the ties.

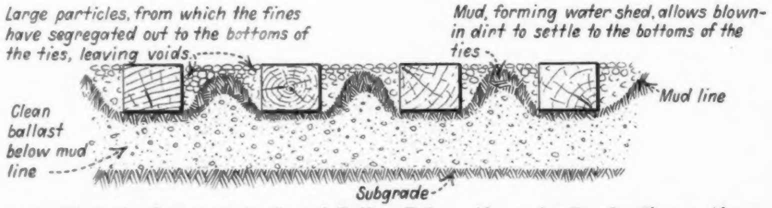
By increasing the sand content of the gravel up to 40 per cent or more, as may seem desirable, the segregation of particles which takes place when too little sand is present, is avoided, and an excellent, stable ballast is obtained. As indicated previously, very fine sand should be excluded, which is not necessary for creating a stable ballast. This leaves sufficient voids in the remaining material for water to drain through readily. In addition to stabilizing the ballast, the large sand content recommended tends to act as a filter, holding wind and train-borne dirt on top of the ballast section, and preventing it from working its way into the ballast and beneath the ties.

### Crushed Gravel

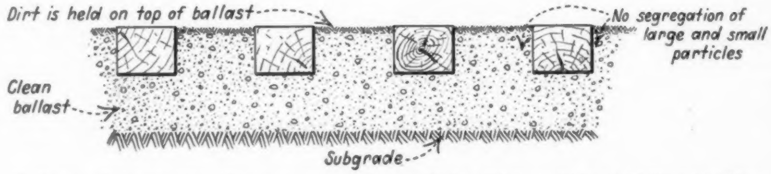
Many deposits of otherwise excellent gravel contain many large particles. Such large particles may indicate a very hard rock composition, which is most desirable. To use such gravel, the large particles must be crushed, the gravel thus being treated much as rock ballast. The crushed particles are then mixed with the naturally formed smaller particles and sand. As the crushed particles are angular, they tend to lock together and thus increase the stability of the ballast.

The current specifications of the A.R.E.A. for prepared gravel ballast, adopted in 1936, contain the following sections relative to General Characteristics, Grading and Deleterious Substances:

**General Characteristics**—Prepared gravel for ballast shall be composed of hard, strong and durable particles of crushed or uncrushed gravel free from




Too Little Sand Content in Gravel Ballast Brings About the Results Shown Above




Sufficient Sand Content Stops Segregation and Holds Dirt on Top of Ballast Section

injurious amounts of soft and friable particles and other deleterious substances, and shall conform to the requirements set forth in this specification:

Grading—Prepared gravel for ballast shall be graded from fine to coarse within one of the sets of limitations in the accompanying table, depending upon the percentage of crushed particles.

**A.R.E.A. Recommendations for Gradation of Prepared Gravel Ballast**

| Size of Square Opening Sieve | 0% to 20% Crushed Max. | 0% to 20% Crushed Min. | 21% to 40% Crushed Max. | 21% to 40% Crushed Min. | 41% to 100% Crushed Max. | 41% to 100% Crushed Min. |
|---|---|---|---|---|---|---|
| | Per Cents Passing Each Size | | | | | |
| 1½ In. | — | 100 | — | 100 | — | 100 |
| 1 In. | 100 | 80 | 100 | 65 | 95 | 60 |
| ½ In. | 80 | 50 | 75 | 35 | 50 | 25 |
| No. 4 | 40 | 20 | 35 | 10 | 15 | 0 |
| No. 8 | 35 | 15 | 10 | 0 | 5 | 0 |
| No. 16 | 25 | 5 | 5 | 0 | - | - |
| No. 50 | 10 | 0 | - | - | - | - |
| No. 100 | 2 | 0 | - | - | - | - |

Deleterious Substances—Prepared gravel for ballast shall not contain deleterious substances in excess of the following amounts:

| | |
|---|---|
| Material finer than 200-mesh sieve | 1 per cent |
| Soft and friable particles | 5 per cent |
| Clay lumps | 0.5 per cent |

In view of the interlocking action in crushed gravel ballast, the proportion of sand in such ballast can be decreased as the percentage of crushed particles increases. This is evidenced in the A.R.E.A. specifications for grading, which indicate that where the crushed particles make up from only 0 to 20 per cent of the whole, the sand content should be from 20 to 40 per cent, whereas if the crushed particles make up from 41 to 100 per cent of the whole, the amount of sand need not exceed a maximum of 15 per cent.

While there is wide acceptance of the A.R.E.A. specifications for prepared gravel ballast, there are a number of roads that find it desirable to modify these specifications, particularly as regards grading, to meet practical conditions on their roads, or their own experience with the action of gravel ballast under traffic. In general, the tendency appears to be toward smaller maximum size ballast particles, and an increased proportion of coarse sand.

One maintenance of way officer who has given considerable study to gravel ballast has indicated his choice of material as follows: "The coarse part of the ballast should all pass a 1-in. square mesh sieve (would prefer a top size of ¾ in.) and be graded uniformly down to what is retained on a No. 8 sieve, with 25 to 35 per cent of the total passing a No. 8 sieve. This grading gives a ballast, which, when unloaded, looks very sandy, and it would appear that in tamping it the bed would be mostly sand. However, by removing ties so that the bed may be examined, it will be found that the tie bed is mostly compacted with large pieces of ballast."

Indicating further deviations from A.R.E.A. specifications in the light of local experience is the recommendation of another maintenance officer, who feels that, in general, the size of the particles in prepared gravel ballast should be from ¼ in. to 1½ in., including about 30 per cent crushed aggregate and 40 per cent sharp sand retained on a No. 20 mesh screen.

There is also a feeling in some quarters that the silt content of prepared gravel ballast should be lower than permitted by the A.R.E.A. specifications. This question is raised because of the fact that there is generally a concentration of silt in the bottoms of the hoppers of ballast cars by the time they are dumped, which, in turn, is concentrated in the track as the ballast is spread. This concentration of silt sometimes starts mud spots in sandy ballast, which would not otherwise occur.

As the result of its study, the committee recommends that most careful attention be given to the location of gravel ballast pits, the character of stone and sand, gradation and freedom from silt, pointing out that all of these factors have an important bearing upon the cost of the ballast itself, and upon the cost of routine track maintenance and the quality of the track that can be maintained.

While the line of least resistance is to use the gravel that is most conveniently located and cheapest, the committee feels that it pays in the long run to insist upon the best grade of gravel possible, especially for heavy-traffic, high-speed lines. It repeats that, from the trackman's standpoint, it is poor economy to accept an inferior ballast for any reason.

Committee—E. J. Brown (chairman), dist. engr. m. of w., C. B. & Q., Galesburg, Ill.; G. L. Griggs (vice-chairman), rdm., C. B. & Q., Ottumwa, Ia.; J. J. Alberts, gen'l. foreman, C.M.St. P. & P., Chicago; E. L. Banion, rdm., A.T. & S.F., Marceline, Mo.; A. R. Bookout, asst. rdm., Sou., Charlotte, N.C.; A. E. Botts, asst. engr. m. of w., C. & O., Richmond, Va.; P. I. Buser, rdm., C.R.I. & P., Estherville, Ia.; R. H. Campbell, stud. appren., Sou., Spartanburg, S.C.; A. B. Chaney, dist. engr., M.P., Little Rock, Ark.; W. E. Chapman, supv'r. C. of Ga., Columbus, Ga.; C. O. Enlow, rdm., A.T. & S.F., Lubbock, Tex.; J. G. Gilley, div. engr., C. & O., Richmond, Va.; H. H. Gudger, rdm., M.P., Monroe, La.; W. H. Hillis, asst. ch. oper. off., C.R.I.& P., Chicago; J. D. Jacobs, supv'r., I.C., Decatur, Ill.; J. B. Kelly, gen'l. rdm., M.St.P. & S.S.M., Stevens Point, Wis.; G. H. Morley, rdm., M.P., Navasota, Tex.; R. T. Rumbold, b & b. supv'r., Sou., Greensboro, N.C.; T. H. Smith, supv'r., L. & N., Russellville, Ky.; J. T. Stotler, rdm., N.P., Spokane, Wash.; E. E. R. Tratman, Wheaton, Ill.; and A. W. Wehner, rdm., S.P., Lake Charles, La.

A Modern Crushing and Processing Gravel Ballast Plant at Cheyenne, Wyo., Which Has a Capacity of 1,000 Tons of Pit-Run Material an Hour

## Discussion

J. M. Miller (W. M.) raised a question as to the relative heaving characteristics of gravel and crushed stone ballast. E. L. Banion (A.T. & S.F.), who presented the report in the absence of Chairman Brown, expressed the opinion that a good

grade of gravel will make a suitable ballast, which will not heave, while a poor grade of gravel will make an imperfect ballast. J. B. Kelly (M.St.P. & S.S.M.) said that he had experienced no heaving in track ballasted with a good grade of gravel, although trouble of this nature had been experienced with trap rock. He predicted that some day a portable machine will be introduced for crushing large stones in gravel ballast, the work being done while the machine operates along the track.

Answering a question, Mr. Banion explained that most companies employ inspectors to protect their interests at gravel pits, although he said that some gravel pits are equipped to provide graded ballast by mixing the various sizes in the required proportions. President Clutz inquired of the committee if the process of scarifying gravel ballast causes fine matter to be worked down into it. Replying, Mr. Banion said this was true, but that in pit-run gravel he had observed very little separation. He said that the sand in the gravel serves as a "blotter" in holding down any mud in the subgrade, preventing it from working up into the ballast. To be effective for this purpose he said that the sand must be of sharp quartz or quartzite particles. He said that some gravel ballast is of such a nature that all the sand can be removed without impairing the effectiveness of the material, while other gravel must contain sand as a means of holding the particles together.

W. H. Sparks (C. & O.) explained that gravel ballast is used on some of the lighter traffic lines on his road, and that a muddy condition similar to that mentioned in the report is sometimes encountered in this ballast. He mentioned that at one time gravel ballast had been used on a heavy-traffic line, but that fine material falling on the surface worked down into the section and caused the ballast to become fouled. To loosen up this ballast, he said that he had attached rails to the wings of a spreader and dragged them through the ballast.

President Clutz explained that at one location on his road where the gravel ballast had become badly fouled, it was dug out at the ends of the ties to a depth of several feet, and the excavation backfilled with sand, with the result that the situation was corrected. Mr. Kelly described one instance on his road in which gravel ballast was placed directly on a red clay subgrade. Within a year, he said, this ballast became badly fouled. In a somewhat similar instance, the subgrade was first covered with a layer of sand, 1½ ft. thick, before applying the gravel ballast, with the result that no difficulty or fouling of the ballast was encountered.

# Present-Day Roadway Drainage—Requirements and Methods

**Report of Committee**

DRAINAGE has been defined as the science of directing the removal of excess surface and ground water in such a manner as to safeguard and promote the best interests of all concerned. The problem of drainage is one which merits the attention of every railroad maintenance of way man, for drainage problems are at the bottom of the majority of all track maintenance troubles.

The rapid increases in speed, weight and density of traffic on American railroads demand a stronger track and more stable roadbed than heretofore. Just as more strength and durability are built into all railroad equipment today, and just as better steel and design are required in rail and fastenings, so we expect and demand a more perfect drainage system to stabilize and protect the roadbed. More money can be saved per dollar spent for the installation of proper drainage than for any other roadway maintenance improvement.

**W. B. Bailes**
*Chairman*

## Types of Drainage

The subject of drainage is so broad and general that it must, of necessity, be divided into three parts: Surface drainage, subsurface drainage and a combination of these two. The problems which arise in connection with railroad drainage fall into one or another of these classifications. The larger percentage of such problems comes under the heading of surface drainage. Under this heading come the problems of surface or intercepting ditches on the tops of cuts, side ditches, and the draining away of impounded water at road crossings and from the inter-track spaces on multiple-track lines.

Surface or intercepting ditches along the tops of cuts are very important and deserve more consideration as to design and maintenance than they generally receive. More trouble is experienced from water in cuts than anywhere else. Diverting this surface water before it reaches the cuts eliminates gullying of the slope surfaces, stops the filling up of side ditches and keeps this extra water away from the roadbed. This is particularly desirable in long, deep cuts.

In selecting the location of intercepting ditches, the character of the soil should be studied. If the soil is of high capillarity, the ditch should be located as far back from the edge of the cut as possible in order that the bank will not become wet and slough off. The drainage area, rapidity of run-off, and average amount of rainfall should determine the size of the ditch. The waste dirt should be thrown toward the cut to insure that water in the ditch does not break over and run into the cut.

## Grade of Intercepting Ditches

The grade of surface ditches is largely determined by the width of the right-of-way where the ditch is constructed. With conditions favorable, the soil composition should be studied and the ditch constructed on such a grade that it will not erode. In case it is necessary that a surface

ditch be constructed on such a grade as will result in erosion, it should be paved. Several methods are employed to pave these ditches. Paving with concrete is expensive, but is resorted to where large quantities of water are to be handled on a very steep gradient. Surface ditches are sometimes lined with rock or old brick. Another method of controlling erosion is to build a series of dams, flattening out the grades between them. It the ditches are already badly eroded, an inexpensive way to remedy the situation is to construct dams in the ditches with brush, rocks, or discarded rolls of fence wire.

The discharge end of intercepting ditches should always be located in such manner that the water discharged will be diverted from the roadbed.

## Side Ditches

Side ditches are a very necessary part of the drainage system of a railway roadbed. Their primary functions are to drain the roadbed and to intercept and carry off the accumulation of surface water and seepage from slopes. Their size should be determined by hydraulic calculations of the size of the water shed, its run-off, and the maximum precipitation in the area in question. To drain the roadbed properly, side ditches should be constructed at least one foot below the subgrade and should be not less than one foot wide at the bottom. The side slopes of the ditch should be light enough to prevent erosion, and on the track side there should be sufficient berm to hold the ballast.

In some cases, where an unusual amount of water is to be drained off, ditches much wider and deeper than the standards mentioned are required. In other cases, it is found that the soil of the roadbed is made unstable by capillary water. This water cannot be drained off, and can be controlled only by lowering the water table. This calls for unusually deep side ditches.

Where on-track equipment is used to shape and maintain side ditches, the grade of the ditch is controlled by the grade of the track. A grade of at least 0.3 per cent is desirable, although a lighter grade than this can be used if necessary. In many cases, where the necessary gradient cannot be obtained by using on-track equipment, the proper grade may be installed by using the more up-to-date off-track equipment.

Side ditches which carry a large amount of water and are on a steep gradient are sometimes paved to prevent washing. They should always be flared away from the track at the ends of cuts, so that any washing which occurs will not be near the track.

The Great Northern has undertaken a bank-widening program in which it is widening its fills in some places to a 24-ft. crown with a 3-to-1 slope. In cuts, the ditches are placed as far from the track as practicable, with a uniformly flat slope extending from the track embankment shoulder to the ditch, and varying between limits of from 6 to 10, to 1. Ditches so located are very desirable where pervious material can be obtained to widen the roadbed. They keep the surface water further from the track,

**Subdrainage Systems of Perforated, Corrugated Metal Pipe Alongside and Beneath Tracks Have Proved Highly Effective**

and, if they are located sufficiently far from the track, off-track equipment can be used in maintaining them and in re-shaping the roadbed.

At places where the surrounding terrain slopes so as to divert the surface water into the railway fill, it has been found advantageous to construct side ditches as remote from the toe of the fill as the right-of-way will permit in order to drain off this water. If the soil is affected seriously by capillary water, it will be found that these ditches will go far toward stabilizing the roadbed. These ditches are sometimes constructed with crawler-mounted dragline ditchers, in connection with re-capping and strengthening the fill where the soil at the toe of the fill is suitable for this purpose.

## Draining Inter-Track Spaces

Any quantity of water that is allowed to stand in inter-track spaces softens the roadbed and is a potential cause of a water pocket under the track. Impounded water is found frequently on the high sides of grade crossings, at bridge abutments and switches, and at the low points in gradients, where the subgrade material is not sufficiently porous to allow quick seepage of surface water. Switches to side tracks and crossover switches on multiple-track lines are often difficult to keep in a smooth-riding condition. In the majority of these cases, the difficulty is due to lack of drainage. Water collects in the inter-track space and without sufficient surface drainage, seeps into the subsoil under the switch, where it causes unstable roadbed conditions. A sure way to find the places where such water collects is to inspect the line after a heavy rain and mark the locations of any ponds of water in the inter-track spaces.

The most satisfactory method of disposing of this surface water in the inter-track spaces is by means of transverse pipe drains. To facilitate cleaning, the pipes should be at least eight inches in diameter. They should be installed well below the subgrade, on as steep a gradient as possible, and should be provided at their upper ends with grating-covered boxes, with a pit of sufficient depth in each case to catch any material that might get through the grating. The outlet ends of such drains should also be protected by gratings to prevent small animals from nesting or hibernating in them. The space intervals at which these pipes should be located depends upon the amount of precipitation, the gradient of the track and the porosity of the soil. Ordinarily, these pipes should be 500 ft. or more apart.

## Subsurface Drainage

Subsurface drainage is the process of eliminating undesirable water from the roadbed by a system of underground drainage. Robert Blith, an Englishman, in the middle of the seventeenth century, wrote of the improvement which might be effected in barren lands by freeing them from an excess of stagnant water on or near the surface by means of channels filled with fagots or stones. So we see that subdrainage is by no means a new idea. When it was first practiced in the United States, rather inconsistent results were obtained. This was caused, undoubtedly, by failure to take into consideration the different types of soil dealt with.

Some of the physical characteristics of soils which influence their serviceability as subgrade material are—moisture-retaining capacity, capillarity, rate of percolation, rate of slaking, volume change, plasticity, internal friction and cohesion. It has been determined that the best soil for subgrades should be a well-graded material of high internal friction and high cohesion, with no detrimental shrinkage, expansion, capillarity or elasticity. The liquid limit and plasticity index should be small. When compacted, this material is stable in wet and dry conditions. If our subgrades were all of similar soil, subdrainage would be unnecessary.

There are two kinds of soil moisture that are of interest to the maintenance engineer. They are gravitational and capillary moisture. Gravitational moisture is that which is free to move under the influence of gravity. The amount present in the soil depends on the perviousness of the soil, the presence of springs and other seepage, and the time since the previous precipitation. It can be removed by ditches or drain pipes.

Capillary moisture, on the other hand, clings to the soil particles by surface tension and reaches the particles either when free water passes through the soil, or by capillary action from a wetter to a dryer stratum. It is not affected by gravity, being able to move upwards as well as in any other direction, and can be removed only by evaporation, freezing or heating, or by subjecting it to great pressure, although it can be controlled by lowering the water table.

The problem of railroad drainage is concerned not alone with the surface moisture that infiltrates into the roadbed, but also with that which flows underground from higher areas. Upon entering the ground, water sinks until it reaches the water table or some impervious stratum. There it either remains or begins to flow laterally to some lower level or outlet. Where such water becomes impounded and does not drain off, there are three general plans for stabilizing the roadbed:

(1) Provide an outlet through the sides of the impervious stratum by means of pipe.

(2) Construct an outlet downward through the impervious stratum into pervious subsoil.

(3) By a system of pipes, lower the water table to such an extent that the soil of the roadbed will be stable.

### Ballast Pockets

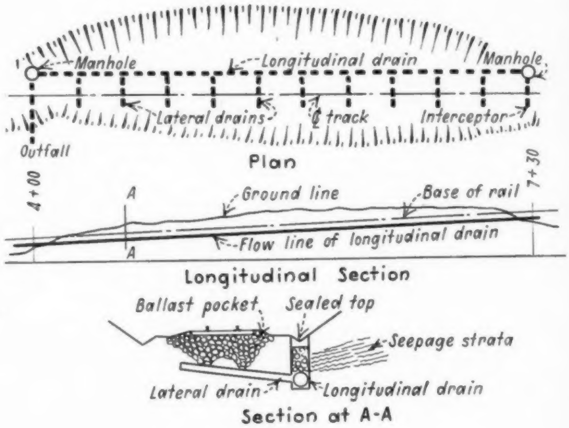
When an impervious subgrade does not have proper drainage, it becomes saturated with water and forms a very unstable support for the track. The track then starts a pumping motion under traffic, which forces the ballast down into the subgrade and muddy water up through the ballast and around the crossties. As more ballast is added and the track is jacked up and surfaced in an attempt to maintain a smooth surface, more ballast is forced into the subgrade, forming a cup-like depression under the rails from which the water cannot escape. This is one cause of weeping or pumping track. The muddy water pumped up fouls the ballast and promotes decay of the ties. The unstable material in the pocket is finally forced laterally and upward to form a bulge at the side of the track. Such bulges bring up mud and dirty ballast and stop up the side ditches in cuts, or cause slides on fills.

The proper solution for the wide range of these drainage problems is almost as varied as the problems themselves. What may be a proper solution for one case may be entirely wrong or wasteful for another.

The installation of proper drainage in a ballast pocket demands a thorough knowledge of the depth, size and shape of the pocket. This can be acquired either by a systematic investigation with a dirt auger or by trenching into the roadbed. After the pocket has been investigated, transverse drains of perforated, corrugated metal pipe should be placed in the lowest part of the pocket, on a grade of not less than 0.5 per cent, and steeper if possible. A layer of straw placed over and around the subdrain pipe will prevent particles of dirt or stone dust from entering the pipe and tending to interfere with the flow of water. By the time the straw has rotted, the backfill and surrounding earth will have become stabilized to such an extent that no great amount of silt will wash into the pipe.

The outlet of the pipe should be high enough above its surroundings so that it will not become clogged. Ordinarily, the upper end of the pipe is closed to keep out the soil or backfill. However, the theory has been advanced that the upper end of the subdrain should, if possible, be extended to open air, thus ventilating it and the surrounding soil. The backfill should be of washed stone, graded from ½ to 3 in. It is best to apply a sealed top to the backfill to keep surface water from washing in silt and stopping up the pipe.

On multiple-track lines, where trouble is experienced from subsurface water in the track and both side ditches, lateral drains beneath the track should be connected into longitudinal drains placed beneath each side ditch. However, investigations have shown that sometimes the subsurface water can be drained more easily and economically by placing the longitudinal pipe between the tracks, with the transverse pipes emptying into it from both sides. When pipe is installed in this manner, it is practical to install riser pipes from the longitudinal pipe, at intervals of about every 200 ft. These are sections of perforated pipe of the same size as the longitudinal drain, and should extend about 12 in. above the surface of the ground. They should be backfilled in the same manner as the rest of the subdrain and should be provided with a grating on top. The riser pipes drain off any surface water between the tracks and furnish ventilation which tends to dry out the subgrade.




**Details of a Typical Pipe Subdrainage System to Cure a Series of Ballast Pockets**

### Ballast Pockets in Cuts and Fills

Ballast pockets or soft spots in fills are usually larger and deeper than those in cuts, but are ordinarily more easily drained. Transverse drains of perforated, corrugated metal pipe, installed as described previously, will drain off the water and stabilize the roadbed.

On very high and wide fills, the impounded water is sometimes located so deep in the fill that it is impractical to ditch down to it in order to install drain pipes. In a case of this kind, the drain pipe is jacked into place. If the line is too long to jack from one setup, then riser and jacking pits are dug in the line and the pipe is jacked from one pit to the next. Several detailed descriptions of this type of subdrainage installations have been described in issues of *Railway Engineering and Maintenance*. One of these is the account of stabilizing an embankment near Marshall, Ill., presented in the issue of January, 1934. Another, in the issue of May, 1940, describes the

drainage of a high fill at Bayou de Chien, Ky.

Ballast pockets in cuts are usually the most difficult to prevent forming or to drain after they have formed. To eliminate surface water from cuts, ditches should be so constructed as to divert the surface water from the track and prevent it from entering the roadbed. If there are wet-weather springs, or seepage planes that are emptying water into the roadbed, the water should be intercepted by open ditches or by a system of subdrainage pipes that will collect and carry it off. Finally, the pockets should be drained.

Transverse drains of perforated, corrugated metal pipe should be placed in the lowest part of the pocket and designed to empty into a longitudinal drain running parallel to the track. Most experienced drainage engineers recommend using pipe no smaller than eight inches in diameter, and some prefer an even larger size. These pipes should be laid on as steep a gradient as possible and backfilled with washed stone, graded from ½ to 3 in. A seal top should be applied to the backfill to keep surface water from washing in silt and stopping up the pipe. Manholes should be constructed in the longitudinal drain about every 300 or 400 ft. In case there is a seepage stratum entering the subgrade from the adjacent slope, the longitudinal drain should be located below this stratum. If it is convenient and not too expensive to open up side ditches to any desired depth, the longitudinal drain may be dispensed with and the transverse drains emptied into the side ditches.

### Subdraining Crossovers and Grouting Ballast Pockets

Frogs in railroad crossovers require more stable foundation than ordinary track. These crossovers are very expensive, and if they are not kept in smooth-riding condition, they are costly to maintain. A correct system of subdrainage pipes with catch basins, properly installed under crossovers, will stabilize the roadbed and reduce maintenance costs materially. Manufacturers have figured that if frogs and crossings were installed over such subdrainage systems, their average life would be doubled.

Many water pockets are formed by building up the sides of the roadbed with impervious material. Year after year more of this impervious material is added to the sides of the roadbed to build up the shoulders and sides of fills as the track is raised on ballast. This tends to form a trough of ballast under the track from which water cannot escape. When water seeps in and fills this space, it would, in the case of heavy-traffic lines, be very expensive to impose slow orders for sufficient time to install the kind of drainage system necessary to dispose of this water. The Portland Cement Association, in co-operation with one large railroad company, has been experimenting with a method of pressure grouting these troughs of subballast in soft spots to keep water out and to stabilize the subgrade.

### Installation at North Point, Md.

One of the first places at which this experimenting was carried out was at North Point, Md., during the early winter of 1936-37. The soft spot selected was one that had resisted stabilization by drainage, by using long switch ties to spread the load, and by using rubble stone in a trench. The grouting at this point was done under the following restrictions: Traffic was not to be interrupted at any time; no slow orders were to be imposed; the riding quality of the track was not to be affected even momentarily; and the grout was not to rise to a height of more than 12 in. below the bottoms of the ties.

Jet pipes were driven into the subballast along the ends of the ties at intervals of three feet. The equipment used for placing the grout consisted of an air compressor capable of delivering 100 cu. ft. of air per min., and a cylindrical grouting machine, with an air lock and charging dome mounted on the top side, in which the grout was mixed and agitated by paddles powered by a three-cylinder air motor. The grout outlet on this machine was through a two-inch standard pipe nipple with a shut-off valve. Grout was conveyed from the machine through several lengths of 2-in. pipe and 25 ft. of 1½-in. rubber hose. The most successful grouting points were 1¼-in. open-end pipe, which were driven down to a point just above the top of the clay. A bolt was inserted in the end of the pipe to afford a driving point. After the pipe was driven, this bolt was rodded out.

The grout was a 1:2 mix applied at 60-lb. pressure. It was applied in each hole until it refused any more. When grout showed up in the ballast one foot below the bottom of the crossties, or if the track started to rise, grouting was stopped. There was a wide variation in the amount of grout accepted by each hole. It was found that if water was forced into the pipe before grouting was started, holes that had refused grout would often take several batches.

After the grout had had time to set up, one transverse excavation was made where grout had been taken in great quantity. This excavation revealed that a concrete slab of fair quality had been formed, the top surface of which was nearly horizontal and had spread laterally from four to five feet each side of the lower end of the point. This slab had a thickness of about 14 in. It was evident almost immediately that the project was successful. The roadbed was completely stabilized and the track has not given any trouble since.

On five projects located near Fort Wayne, Ind., similar to the one just described, a careful record of costs showed that the work cost $2.52 per linear foot of track grouted. A close comparative maintenance record showed that 82 per cent of the maintenance labor was saved by treating these pockets with grout.

### Driving Poles or Ties

Another method that has been used to a considerable extent in recent years to stabilize the roadbed, in both cuts and on fills, where trouble has been experienced with water pockets and mud heaves, is that of driving ties or poles at the ends of the crossties. During the last five years, several hundred miles of track have been treated in this manner in Texas alone. Here, after a careful investigation of roadbed conditions, pieces of timber (usually cull ties or unpeeled poles) of the proper dimensions and length have been selected and driven, employing specially designed, track-mounted driving equipment.

It is said that this manner of stabilizing soft track produces immediate results, and that where used it has brought about a large reduction in the track maintenance labor required, and also in the amount of replacement ballast needed. In some cases, the return on the cost of the work is said to have been in excess of 50 per cent per annum. Furthermore, it is said that installations made as long as 20 years ago, are still proving effective.

Committee—W. B. Bailes (chairman), supvr., Sou., Charlottesville, Va.; P. L. Koehler (vice-chairman), div. and channel engr., C. & O., Ashland, Ky.; A. N. Burgett, supvr., Erie, Huntington, Ind.; H. C. Fox, supvr., Sou., Spartanburg, S. C.; J. W. Hopkins, supvr., B. & L. E., Greenville, Pa.; T. F. King, rdm., Sou., Asheville, N.C.; G. B. McClennen, rdm., T. & P., Marshall, Tex.; F. H. Masters, ch. engr., E. J. & E., Joliet, Ill.; G. M. O'Rourke, asst. engr. m. of w., I. C., Chicago; O. V. Parsons, asst. engr., N. & W., Roanoke, Va.; M. W. Rector, vice-pres., W. H. Nichols Company, Dallas, Tex.; G. S. Turner, engr. m. of w., D. & S.L., Denver, Colo.; F. G. Walter, asst. engr., I. C., Chicago; A. E. Hendrix, supvr., Sou., Clarksville, Va.; C. M. Burpee, managing editor, Railway Engineering and Maintenance Cyclopedia, Chicago; C. R. Schoen-

field, rdm., C.B. & Q., Aurora, Ill.; L. J. Gilmore, rdm., G. N., Superior, Wis.; and J. Cranford, rdm., M. P., Hope, Ark.

## Discussion

All through the discussion of this paper, the necessity for adequate and dependable drainage of the roadbed was stressed by almost every speaker. A. L. Kleine (D. & R.G.W.) emphasized the desirability of intercepting drainage water on the uphill sides of cuts before it has an opportunity to get into the roadbed. He also called attention to the practice, often followed when widening shoulders and embankments, of placing the shoulder material higher than the foot of the ballast, stressing the fact that this is certain to result in the impounding of water in the roadbed and subsequent soft spots.

E. L. Banion (A.T. & S.F.) called attention to the fact that efforts are sometimes made to drain water pockets without full knowledge of the conditions, and took the position that money spent in the exploration of water pockets before any plans for drainage are made, is money well spent, and that such exploration often represents the difference between failure and success of the drainage project. He stated that in his experience it has often happened that an impervious stratum of clay or shale overlays a pervious stratum into which the water from soft spots can be drained, and suggested the driving of shod piling, particularly on fills, to obtain a vertical channel for this drainage.

He also called attention to the necessity for selecting proper materials for backfilling over corrugated metal pipe, stating that locomotive cinders are not satisfactory since they tend to disintegrate and clog in the drains. It was his belief that it is good practice to put crushed stone over the pipe, but that gravel ballast should never be put in over this rock. He also questioned the economy of driving long piles to cure soft spots in embankments, and advocated the placing of a blanket of impervious material over a soft spot.

According to F. J. Meyer (N.Y.O. & W.) much of the present trouble with roadbed drainage is the result of carelessness of the construction forces before the line is put in operation. He cited instances where the center of rock cuts is lower than the sides, causing water to flow into and remain under the tracks. In many cases fills were not consolidated, and almost with the initial operation, ballast was forced into the subgrade, causing water pockets. He contended that surface ditches in cuts should have ample section and sufficient grade.

Following this, there was an extended discussion of the possibility of perforating impervious strata to lead drainage from water pockets into lower pervious strata, and various methods, including boring with well augers, were suggested.

F. W. Tomlinson, Jr. (Penna.) cited instances in the territory under his jurisdiction where it is almost impossible to keep side ditches open owing to the fact that the clay soil in the bottom of the cut sloughs off and fills them. After a number of experiments it was found that a blanket of cinders four to six inches deep completely cured the trouble.

W. H. Sparks (C. & O.), taking the position that the necessity of eliminating water in the roadbed is so great that it over-shadows all other considerations, said that in most cases where drainage is needed, the cost of the work should be the last item to be given consideration.

# Maintaining Right-of-Way Fences—Organization and Methods

**Report of Committee**

F. J. Meyer
*Chairman*

WELL-constructed and properly maintained fences were never needed more than they are today. Over a period of years we find that the railways either built fences for their own protection or were required to build them by law in the different states through which they ran.

The earliest railway fences probably followed the types used on local farms. Among the earliest forms were the worm, and post and rail fence. Adjacent to highways, tight-board fences were erected so that the locomotives would not frighten horses. Many tight-board fences were built as combination right-of-way and snow fences. Frequently these were located so close to the tracks that during the winter they made a deep cut out of a shallow one, and so added to the difficulty of snow removal. Today, the tendency seems to be toward the use of portable snow fences, located sufficiently far from and at the proper angle to the track to make an effective wind break; 150 ft. has been suggested as the minimum distance desirable to be effective.

It having been found that it was not only hazardous, but costly, to operate a railway through sections of the country where cattle are pastured or where stock roams, without fences, certain standards for railway fences came into general use. As timber became more valuable and labor costs higher, and as more durable and better-looking fences became desirable, wire fence came into more general use. Furthermore, the growth of the country and the recognition of right-of-way fence as a necessity, resulted in the practical development and application of specifications for "hog-tight," "bull-strong" and "horse-high" fences.

For a number of years, fencing programs were carried out to such an extent that well-maintained fences were found almost everywhere along the railway right-of-way. That these fences were well built is evidenced amply by the small expenditures that have been made for fence repairs during the recent years of railway "starvation."

At the thirty-sixth annual convention of this association, held in 1918, a report on "Fences, Anchoring of Fences, Gates and Cattle Guards" was presented. Two paragraphs from that report follow:

"Maintenance of Fences—It is the intention of the railroads and their maintenance officers to keep their fences in good condition at all times, but due to the shortage of labor and other work, they are given the last consideration and frequently we find that at the end of a working season no repairs have been made to them; and material allotted for this purpose is carried over to another season. With the postponement of the work from one season to another, it is natural that the fences reach such a condition that they require complete rebuilding, which is more expensive than if they had been properly maintained at all times.

"It is the opinion of this committee that in order to keep fences in proper repair, a small fencing crew, consisting of a foreman and four or more men, should be kept on each roadmaster's or supervisor's subdivision. By this arrangement better work will be obtained and more accomplished, as men constantly engaged in the work will be more efficient; also, under this arrangement, it will not be necessary to distribute the fence material to the various sections."

### Still a Problem

During the 23 years since this earlier report was made, the fences along our railways generally have not been maintained as well as they were being maintained when that report was written. For lack of funds, most railways have had to limit maintenance largely to the track structure.

We are now faced with a problem not unlike that which confronted maintenance officers before the present fences were built. Much of the right-of-way, cleared and mowed for years, is now covered with weeds and brush, and, in many locations, it is with difficulty that traces of fences can be found. Cattle range or are pastured behind this brush; while between the rows of brush, trains move at higher and higher speeds. In fact, weeds flourish in many miles of track, so that weed burners and weed poisons must be used extensively. Obviously, cattle on the track may result in serious derailments.

Weeds in the track and in the ditches must be destroyed as a matter of economical maintenance. The arsenic in certain poisonous weed killers attracts animals for quite a distance and cannot be used except in well-fenced territory without killing stock. In densely populated districts of the country, industrial type fence is often required.

Recognizing the vast difference in the topography of the thousands of miles traversed by the railways of this continent; the difference in the requirements of the various railways due to the varying traffic and the variety of uses to which adjoining lands are put; and the widely varying laws governing the kinds of fence required in each state, the American Railway Engineering Association has adopted and published in its Manual of recommended practice, specifications for a number of types of fences which seem to meet all conditions found on the railways. For types of fences to meet various conditions, we recommend the consideration of these A.R.E.A. standards.

### Methods of Maintenance

The best way to maintain right-of-way fences where section gangs are still the basis of the track organization, is for the section gangs to make repairs as and when needed. This work should be done at times when they cannot work on the track, and when other duties or weather does not interfere, care being exercised to see that fence is built only where it is absolutely needed.

Creosoted Timber Posts Have Long Life and Present a Neat Appearance

Where long districts are covered by patrols and major track maintenance is carried out by large and more or less specialized gangs, the patrols, of course, can make only minor repairs. In off seasons, when the specialized gangs are not engaged in their regular work, enough men to maintain the fences properly (possibly 8 or 10), should be selected from these gangs and organized into fence gangs. Specialized gangs will build more and better fence per dollar than can be built by section forces. We have been informed that contractors have built fence for less money than railway forces. One road has reported contracting straight fence rebuilding on one division, involving three barbed wires and 26-in. woven-wire, at 15 cents per rod while on another division, 25 cents per rod was paid.

Farmers will sometimes repair the fencing along their own property for a reasonable sum of money. At the same time, when it is possible to use regular track forces for this work, it is best to use them, if for no other purpose than to help stabilize their employment. However, men should not be taken from necessary track maintenance work to build fences.

When more than 50 per cent of the material in a fence requires renewal, it is economical to rebuild the fence. When less than 50 per cent of new material is required and the general condition of the fence is good, spot repairs should be made.

### Inspection

Foremen should make an inspection of the fences on their respective sections during the early spring for a tentative report, covering the material required for each section, and giving ample time to arrange for the purchase of material. The spring inspection should be followed by a fall inspection, made jointly by the roadmaster and section foreman, for the final decision as to what fence will be repaired out-of-face and what will require only spot repairs. A program can then be made and the work scheduled to start as soon as practicable.

Early in the year, men can be obtained more easily; the digging is frequently easier; the weather is cooler; and insects are less bothersome—all of which affect favorably the production of fencing forces. New material should be shipped as near as possible to the points where fence work is to be done, just prior to starting the work. It can then be trucked to the job on motor cars and trailers, or distributed by motor trucks over the highways. Work-train expense should be avoided. Material should not be shipped to and stored at the point of use far in advance of the time the

work is scheduled to start, as it will deteriorate and is subject to theft.

To get the greatest benefit from each dollar spent for fencing, only such fences should be maintained as are actually necessary to prevent stock from entering the right-of-way. There are many plowed fields and other places where stock is not pastured, where it is economical to defer fencing. Unless required by law, fences should not be maintained between the right-of-way and adjacent highways. On the other hand, an adequate fence of good appearance, built of good materials and to a standard providing for proper construction, should be maintained where required.

#### Makeshift Materials Undesirable

Makeshift methods of fence maintenance are not economical. The economy of using old boiler flues, old pipes and old timber for posts may be properly questioned. The cost of these materials per fence year is not known. The cost of labor is a large item in fence maintenance and it must be very high when old ties and lumber are worked up for fence posts in substitution for suitable metal or treated timber posts.

It is recognized that, on many roads, it may, for one reason or another, be necessary to postpone a sizable fence program. Confronted with such a possibility, and when new material is not available, boiler flues, old pipe, split ties and trees on the right-of-way should be saved for making fence repairs. Discarded telegraph wire can be used to patch with, if necessary.

It is a question whether cattle guards should be maintained at highway crossings. They are expensive to build and are not effective. Many roads maintain cattle guards only in states where the free ranging of stock is permitted.

Substantial anchorage at the ends of straight runs of fence, and even intermediate anchorage, is important. Corners should be well braced. Standard plans should be followed for the sake of uniformity. Posts, as a rule, are set on the railway side of the fence, but on curves they should always be set on the inside of the curve. Land should be drained so that fences do not stand in water for ice breaks the wire, pulls it off the posts and heaves the posts out of the ground.

A Well-Constructed Fence Employing Steel Posts

Last, but by no means of least importance, is the farm gate. Probably more gates are left open because they are too hard to close than for any other reason, and a 16-ft. opening is a big hole in a right-of-way fence.

Committee—F. J. Meyer (chairman), rdm., N. Y. O. & W., Middletown, N. Y.; L. C. Blanchard (vice-chairman), rdm., C M. St. P. & P., Spencer, Iowa; L. L. Smith, rdm., C. B. & Q., Centralia, Ill; R. W. Lucas, rdm., C. R. I. & P, Manly, Ia; J. F. Ryan, supvr., D. & H, Plattsburg, N. Y.; C. Halverson, rdm., G. N., Grand Forks, N D.; T. N. Turner, rdm., M. P., Newport, Ark.; H. H. Britton, supvr., N. Y. C., Adrian, Mich.; J. F. Barron, rdm., Sou., Selma, Ala.; R. L. Fox, rdm., Sou., Alexandria, Va.; N. Bridges, rdm., A T. & S. F., Newton, Kan.; T. A. Gregory, rdm, N. P., Minneapolis, Minn.; E. E. Edwards, rdm., S. P., Oakridge, Ore.; C. M. Hayes, gen'l. rdm., M. St. P. & S. S. M., Minneapolis, Minn.; H. E. Kirby, asst. engr., C. & O., Richmond, Va.; and J. C. Runyon, supvr., Chesapeake & Ohio, Covington, Kentucky.

## Discussion

Chairman Meyer expressed the opinion that the practice of discontinuing the mowing of the right of way, cutting brush in the winter and subsequently burning it, was responsible for a lot of damage to fences. F. H. McKenney (C. B. & Q.) said that his problem was weeds, particularly tumbleweeds, and not brush. He added that the tumbleweeds are blown by the wind for great distances and accumulate against the fences, sometimes even breaking them down. Burning the weeds in the fence, he pointed out, is not only liable to burn out fence posts, but also to burn the galvanized coating off the wire, making it susceptible to rust.

R. E. Chambers (A.T. & S.F.) said that where the accumulations of tumbleweeds were bad, he had successfully used crawler tractors equipped with angle dozers to plow the weeds away from the fence and, at the same time, plow a light furrow in the ground along the fence, thereby permitting the weeds to be burned without damage to the fence. He also cited an instance where bulls forced their way through barbed wire fences and on to the right of way. "The situation was corrected," he said, "by installing steel stays in the middle of each panel between fence posts."

E. L. Banion (A.T. & S.F.) asked if the committee had considered the use of electrically-charged fences, which have been used quite extensively by many farmers. Chairman Meyer replied that the subject had been considered by the committee, but that it was decided not to include reference to these fences in the report, since a committee of the American Railway Engineering Association dealing with fences had hesitated to recommend them.

J. B. Kelly (M.St.P. & S.S.M.) said that Wisconsin farmers are making general use of electrified fences made up of one or two wires supported by posts spaced approximately 40 ft. apart, which, he pointed out, are very economical to construct. He added that stock soon learns to stay away from the wire, after which the current can be disconnected for long periods of time. Mr. McKenney thought that electrified fences should be tried by the railroads, particularly in locations where trouble is experienced with livestock, although he conceded that the practical difficulties of maintaining large amounts of such fence would be much greater for the railroads than they are for individual farmers.

President Clutz called attention to the fact that the report did not say anything about the importance of maintaining right-of-way markers in locations where right-of-way fences do not exist, or where the fences are not located on the right-of-way line, and added that numerous cases had occurred where the railroads had lost valuable property because right-of-way markers had not been maintained. Chairman Meyer agreed with Mr. Clutz concerning the importance of right-of-way markers in many instances, and added that in some cases land grants to the railroads stated expressly that only the land needed for right-of-way should be fenced.

E. C. Argust
*President*

Ross M. Blackburn
*President-Elect*

Lewis Thomas
*Secretary-Treasurer*

# Track Supply Association Holds Large, Constructive Exhibit

ALTHOUGH the Track Supply Association as it exists today is by no means as old as the Roadmasters' Association, the idea of exhibiting tools and materials required for the construction and maintenance of track originated at the second annual convention held at Indianapolis, Ind., in 1884. It is of special interest that similar exhibits have been presented at every succeeding convention except two, these being at Chicago and St. Louis in 1893 and 1904 respectively, and it is no exaggeration to say that, particularly in recent years, the exhibit has played an important part in the success of the conventions.

Indicating a wholesome response to the increased activity in all branches of railway maintenance during the year and to the prospects for still greater activity next year, 56 manufacturers of materials and equipment used in track maintenance presented exhibits requiring 81 exhibit spaces, compared with 55 companies and 75 exhibit spaces last year. Six of these companies presented exhibits before the roadmasters for the first time, while another had not presented an exhibit for more than 10 years.

The officers of the Track Supply Association who were responsible for the planning, preparation and conduct of the exhibit this year were: president, E. C. Argust, vice-president and secretary, Morden Frog & Crossing Works, Chicago; first vice-president, R. M. Blackburn, Buda Company, Chicago; second vice-president, H. C. Hickey, The Rail Joint Company, Inc,. Chicago; secretary-treasurer, Lewis Thomas, general sales manager, Q & C Company, Chicago; directors, R. J. McComb, vice-president, Woodings-Verona Tool Works, Chicago (ex-officio); J. J. Clutz, Pennsylvania, Indianapolis, Ind. (honorary); George W. Morrow, Reade Manufacturing Company, Chicago; F. H. Philbrick, Power Ballaster Corporation, Chicago; J. C. Rinehart, Eagle Grinding Wheel Company, Chicago; T. D. Crowley, Creepcheck Company, Chicago; H. W. Cutshall, Electric Tamper & Equipment Company, Chicago; and H. M. McFarlane, O. F. Jordan Company, East Chicago, Ind.

In the election of officers for the ensuing year, Mr. Blackburn was advanced to the presidency; Mr. Hickey was made first vice-president; Mr. McFarlane was elected second vice-president; and Mr. Thomas was reelected secretary-treasurer. The new directors elected for two years were: C. B. Armstrong, Air Reduction Sales Company, Chicago; C. O. Jenista, Barco Manufacturing Co., Chicago; and J. B. Templeton, Templeton, Kenly & Co., Chicago. F. A. McGonigle, manager railway sales, Mall Tool Company, Chicago, was elected to fill the vacancy resulting from Mr. McFarlane's advancement.

A list of the exhibitors, the products shown and the names of their representatives present, follows:

### Exhibiting Members

**Air Reduction Sales Company,** New York—Welding and cutting equipment; oxygen and acetylene regulators; pipe welding; rail cropping; butt-welded rail; built-up rail joints; flame-cleaning torch—C. B. Armstrong, C. A. Daley, J. F. Franzen, J. W. Kenefic, L. C. McDowell, U. F. Portell, D. N. Newland, E. F. Turner.

**American Fork & Hoe Company,** Cleveland, Ohio—Rail anchors; tapered rail joint shims; shovels; weed cutters; ballast forks; rakes; scuffle hoes; broom rakes; axes; hammers; scythes—H. C. Branahl, C. C. Connolly, G. L. Dunn, S. L. Henderson, H. S. Johnson, J. J. Nolan, D. L. O'Brien, Frank J. Reagan, John Skeel, R. J. Whalen.

**Armco Railroad Sales Company,** Middletown, Ohio—Samples of pipe and interlocked and clip-type sheet piling; models of bin-type retaining wall, multiplate pipe and portable airline; subdrainage photographs—R. Y. Barham, E. T. Cross, R. B. Faries.

**Barco Manufacturing Company,** Chicago—Gasoline tie tampers; gasoline hammer—F. N. Bard, W. J. Belhke, C. A. Cox, C. O. Jenista, W. T. Jones, L. J. Lytle, J. L. McLean, C. L. Mellor, F. B. Nugent.

**Buda Company,** Harvey, Ill.—Inspection motor car; 2-4 man inspection car; switch stand; bonding drill; track drill; track liner; rail bender; journal jacks; track jacks; hydraulic jacks; pole jacks; automatic lowering jacks; tie puller; and tie nipper, tool grinders, bumping posts—R. M. Blackburn, H. H. Cohenour, J. S. Dempsey, W. Ebert, R. B. Fisher, F. L. Gormley, J. F. Hartley, W. H. Haas, R. K. Mangan, W. T. Mulcahy, L. Kerlin, D. Richards, M. S. Rotroff, J. W. Sanford, G. A. Secor, L. O. Stratton, E. H. Walker, R. P. Williamson.

**Chicago Pneumatic Tool Company,** New York—Pneumatic tamper; gasoline tamper; power-vane impact wrench; portable compressor; spike driver; pneumatic and electric grinders and nut runners—J. A. Congdon, Jr., C. L. Butler, H. R. Deubel, T. P. Harris, H. J. Maginnis, W. Pallowick, E. S. Rosselle.

**Chipman Chemical Company, Inc.,** Bound Brook, N.J.—Weed killer—C. M. Bernuth, N. J. Leavitt, W. H. Moyer, I. J. Strain.

**Conley Frog & Switch Company,** Memphis, Tenn.—Expansion joints for fixed span, swing and bascule bridges; solid manganese spring frogs; turntable frogs; frogs for rail laying work and wrecking service—E. H. Baumgarten, J. E. Conley, L. J. White.

**Creekcheck Company, Inc.,** Newark, N.J.—Rail anchors—T. D. Crowley, N. A. Howell, W. H. Remmel.

**Crerar, Adams & Co.,** Chicago—Track and bonding drills; track tools; pipe wrenches; tool handles; tie, lumber and other marking crayons; air skilsaws and electric hand drills; track and switch brooms—R. W. Beasant, Geo. J. Doyle, A. Kopala, I. E. Poehler, J. M. Temple.

**Cullen-Friestedt Company,** Chicago—Moving pictures of Burro locomotive crane in operation; rail tongs—W. C. Bamber, K. J. Beller, L. B. Bertaux, C. J. Bronez, E. V. Cullen, F. J. Cullen, F. P. Cullen, T. G. Frazee, G. H. Goodell, Robert W. Jamison, F. L. Kendig, Jos. F. Leonard, James E. Simkins, Wm. J. Roehl.

**A. P. deSanno & Son, Inc.,** Phoenixville, Pa.—Radiac grinding wheels—N. A. Conway, Jr., Wm. Lukey, L. G. Martin, E. J. Rohan.

**Duff-Norton Manufacturing Company,** Pittsburgh, Pa.—Track jacks; power

jacks; journal jacks; automatic lowering jacks; tie spacers; tie remover—E. C. Gunther, J. F. Van Nort.

**Eagle Grinding Wheel Company,** Chicago—Grinding wheels—John Abram, L. E. Buckingham, C. L. Frame, J. C. Rinehart.

**Elastic Rail Spike Corporation,** New York—Elastic rail spikes—C. M. Bernuth, William A. Fisher, A. C. Jack, B. Kuckuck.

**Electric Tamper & Equipment Company,** Ludington, Mich.—Electric tie tampers; 4, 8-tool power units; tamping tools; and assorted blades—H. W. Cutshall, Wilbur Davis, Raymond Hermann, L. S. Osborn, G. L. Walters.

**Fairmont Railway Motors, Inc.,** Fairmont, Minn.—Inspection car; section car; and extra-gang bridge and building car—C. P. Benning, W. D. Brooks, Kenneth Cavins, W. G. Day, Arthur R. Fletcher, W. F. Kasper, J. T. McMahon, V. Pagett, Ralph W. Payne, C. L. Rager, W. H. Ripken, H. A. Sly, J. P. Wainscott, William Williamson.

**Hayes Track Appliance Company,** Richmond, Ind.—Literature and models of bumping post, derails and wheel stops—S. W. Hayes, Jr., Herbert J. Mayer, John H. Sullivan.

**George M. Hogan & Co.,** Chicago—One-man track tool—V. G. Cartier, J. T. Flynn, G. M. Hogan, G. M. Hogan, Jr., D. L. O'Brien.

**Ideal Power Lawn Mower Company,** Lansing, Mich.—Tractor and snow plow; straight type roto-sweeper—L. L. Beresford, Robert E. Bradley.

**Illinois Malleable Iron Company, Railroad Division,** Chicago—Rail anchors—Chas. G. Ericson, Dayton T. Hogg, John C. Kuhns, H. A. Morean.

**Ingersoll-Rand Company,** New York—Spot tamper compressor; screw spike driver; rail drill; grinder; wood borer; impact wrench; track wrench; tie tamper; spike driver; and cribbing fork—G. E. Bridge, W. J. Hinz, H. L. Kent, K. I. Thompson.

**O. F. Jordan Company,** East Chicago, Ind.—Model and pictures of spreader ditcher and snow plow—A. W. Banton, J. C. Forbes, H. M. McFarlane, C. W. Shipley.

**Joyce-Cridland Company,** Dayton, Ohio—Air motor jacks; automatic lowering jacks; journal jacks; bridge jacks; self-lowering ball bearing screw jacks; track or trip jacks—Huston Brown, C. N. Thulin, E. E. Thulin.

**Kalamazoo Railway Supply Company,** Kalamazoo, Mich.—One-man inspection car; light section motor car; signal-maintainer car; motor-car wheels; track gage and level; and extra gang power car—L. Boswell, G. E. Bridge, Ralph E. Keller, Frank E. McAllister, Robert McAllister, E. C. Poehler, P. J. Robischung.

**Link-Belt-Speeder Corporation,** Chicago—Photograph of shovels and locomotive cranes—L. P. Spillan, N. A. Weston.

**Lundie Engineering Corporation,** New York—Rail clips; tie plates; tie tongs; rail lubricator—L. B. Armstrong, O. W. Youngquist.

**Maintenance Equipment Company,** Chicago—Switch-point protector; rail and flange lubricator; derail; and literature on rail layer—E. Overmier, T. E. Rodman, P. J. Wolf, P. A. Wells.

**Mall Tool Company,** Chicago—Gasoline and electric rail grinders; cross slotters; concrete vibrators and surfacers; bridge and building machines; gasoline, electric and air-driven chain saws; gasoline and electric drills and circular saws; power wrenches; flexible-shaft grinders and polishers—R. F. Burgwald, S. Gromnicki, J. Innes, A. W. Mall, F. A. McGonigle, M. Rhenquist.

**Mississippi Supply Company,** Chicago—Switch heater; tie nipper—R. J. Mulroney.

**Morden Frog & Crossing Works,** Chicago—Adjustable rail braces; forged-steel braces; Sampson switch point; standard switch point; new saw-toothed adjustment for adjustable braces—E. C. Argust, W. Homer Hartz, G. F. Killmer, L. I. Martin, L. C. Reebs.

**Moto-Mower Company,** Chicago—Power sickle-bar mower; power lawn mowers; and hand mowers—L. C. Meskimen, J. O. Spottswood, Mrs. L. C. Meskimen.

**Nordberg Manufacturing Company,** Milwaukee, Wis.—Rail grinders; track power drill; power track wrench; utility rail grinders; surface grinders; precision grinders; accessories—C. P. Clemmens, W. W. Fitzpatrick, C. K. Jensch, John Hogan, Eugene Larson, Ralph W. Payne, F. M. Read, Stanley H. Smith, H. H. Talboys, W. E. Bugbee.

**Northwestern Motor Company,** Eau Claire, Wis.—Bridge-and-building gang car; all-service section car; light all-service car; heavy-duty extra gang and hump cars—F. W. Anderson, Otis B. Duncan, Geo. H. Goodell, Gilbert Heithaus, C. E. Murphy, A. H. Nelson.

**Oliver Iron & Steel Corporation,** Pittsburgh, Pa.—Gage rods; heat-treated track and switch bolts; screw spikes; drive spikes; and wrenchtite nuts—B. J. Beck, G. M. Daly, J. G. Graham, John R. Olsen.

**Oxweld Railroad Service Company,** Chicago—Oxy-acetylene welding and cutting apparatus; oxygen; acetylene; carbide; rail butt welding; heat-treating of rail ends; pipe welding; wrinkle bending pipe; angle bar straightening; acetylene flood lights, railroad type—Lem Adams, M. C. Beymer, G. P. Bogert, M. Burnett, Jr., W. E. Campbell; R. J. Dodds; W. E. Donalds; F. J. Duffie; H. V. Gigandet; E. B. Hall, Jr.; F. C. Hasse, P. Hunter, Jr., J. W. Lacey, G. B. Moynahan, J. H. Rodger, H. W. Schulze, J. C. Stephenson, F. E. Teichen, J. E. Winslow.

**P. & M. Company,** Chicago—Rail anti-creepers; bond-wire protectors; and tie plate assemblies—S. M. Clancey, J. J. Gallagher, D. T. Hallberg, G. E. Johnson, L. S. Johnson, J. E. Mahoney, W. A. Maxwell, F. A. Preston, G. E. Olson, M. K. Ruppert.

**Pettibone Mulliken Corporation,** Chicago—Mechanical switchman; switch stands—W. A. Enstrom, C. A. Johnson, Carl Landberg, W. E. Olds, G. J. Slibeck.

**Pocket List of Railroad Officials,** New York—Copies of Pocket List of Railroad Officials—Harold A. Brown, B. J. Wilson.

**Positive Rail Anchor Company,** Chicago—Rail anchors; guard-rail plates and braces; adjustable rail braces—L. C. Ferguson, R. J. Platt.

**Power Ballaster Company,** Chicago—Motion pictures of power track ballaster and power track cribbing machines; ballast cleaning machine—W. E. Bugbee, Ralph Payne, F. H. Philbrick, L. L. Schreck, Stanley H. Smith.

**Q & C Company,** New York—Guard-rail clamp; switch-point guard; compromise joints; derail; gaging tools; wheel stops; rail tongs; gage rods; flange-way guard; adjustable rail brace; electric switch heater—G. H. Goodell, M. Iseldyke, L. E. Hassman, G. Prest, Lewis Thomas.

**Rail Joint Company, Inc., The,** New York—Insulated rail joints; standard joints; compromise joints; and fibre insulation—Alex Chapman, E. A. Condit, W. E. Gadd, Harry C. Hickey, G. H. Larson, J. N. Meade, R. W. Payne, C. H. Reade, Thomas Ryan.

**Rails Company, The,** New Haven, Conn.—M. & L. track; compression track fastenings; compression screw spike; full-throated cut spike; oil, gas and electric switch heaters; track lubricator; spring spike; automatic switch lock; strip welding for building up battered rail ends; acetylene tank carrier—R. E. Bell, L. T. Burwell; W. A. Peck, J. V. Wescott.

**Railway Engineering and Maintenance,** Chicago—Copies of *Railway Engineering and Maintenance* and *Railway Age*—G. E. Boyd, C. M. Burpee, M. H. Dick, S. W. Hickey, N. D. Howard, Elmer T. Howson, F. C. Koch, J. G. Little, C. W. Merriken, H. A. Morrison, J. S. Vreeland.

**Railway Maintenance Corporation,** Pittsburgh, Pa.—RMC plastic cakes for joint lubrication; pictures of elastic stop nut—John F. Casey, Jr., J. B. McWilliams.

**Railway Purchases and Stores,** Chicago—Copies of publication—K. F. Sheeran, Edward Wray.

**Railway Track-Work Company,** Philadelphia, Pa.—Portable track grinders; stock-rail grinders; flexible-shaft grinders; combination grinders; accessories; grinding wheels—H. M. Moorhead, A. M. Nardini.

**Ramapo Ajax Division, American Brake Shoe & Foundry Company,** New York—Switch stands; rail lubricators—T. E. Akers, G. A. Carlson, J. E. Davidson, R. E. Einstein, H. Hazelton, A. F. Hess, Darcy F. Hilton, J. V. Houston, A. F. Huber, J. S. Hutchins, J. P. Kleinkort, E. F. Needham, R. W. Payne, W. A. Peddle, H. W. Renick.

**Sperry Rail Service,** Hoboken, N.J.—Examples of transverse fissures, engine-burn fractures and flash butt welds; literature—E. A. Crawford, J. C. Davis, C. W. Gennet, Jr., W. F. Kohl, S. R. Lewis, C. K. Mentz, S. P. Murphy, H. C. Plunkett.

**Templeton, Kenly & Co., Ltd.,** Chicago—Track, bridge and journal jacks, with exclusive wheel hold-down; car-retarder jacks; tie spaces; rail puller and expander—W. C. Cornu, H. C. Dilsizian, R. B. Hill, W. H. Kreer, P. H. McManus, William Simpson, J. B. Templeton, W. B. Templeton.

**Warren Tool Corporation,** Warren, Ohio—Flex-Toe claw bar; track tools—W. H. Bon, F. J. Lehman, Howard Mull, O. W. Youngquist.

**Wheeler Lumber Bridge & Supply Co.,** Des Moines, Iowa—Laminated crossings and culverts—C. M. Mitchell.

**Woodings-Verona Tool Works and Woodings Forge & Tool Company,** Verona, Pa.—Rail anchors; triflex springs—W. W. Doehn, A. C. Laesing, R. J. McComb, G. L. McKewin, J. M. Moore, E. Woodings, W. H. Woodings.

**Woolery Machine Company,** Minneapolis, Minn.—Tie cutting machine; creosote-spray machine—A. J. Franke, H. E. Woolery, W. F. Woolery.

**Worthington Pump & Machinery Corp. (Construction Equipment Division),** Holyoke, Mass.—Off-track tie-tamper compressor—P. A. Blakeley, A. L. Davis, S. F. Evelyn, W. J. Fleming, G. W. Morrow, H. J. Ryan, H. J. Shultz.

# WHAT'S the Answer?

## Inspecting Turntables

*How frequently should a turntable be inspected? By whom? How should the inspection be made? What details should be observed?*

### Has System Inspector

By F. H. Cramer
Bridge Engineer, Chicago, Burlington & Quincy, Chicago

All turntables should be inspected not less than twice a year, and should be raised once a year for a detailed inspection of the center bearing. A representative of the bridge engineer's office should be present when the table is raised for the center inspection and should go over the entire table in detail at that time. The master carpenter makes the semi-annual inspection, which is made without lifting the span, unless there is some definite reason for doing so.

Our practice heretofore has been to inspect all turntables twice a year, with quarterly inspections at the more important points. Improved designs of center bearings, and tests and experiments to improve lubrication, have permitted a reduction in the number of inspections of even the more important spans.

On the Burlington the complete inspection is made by a representative of the bridge engineer, who specializes in this work and who is allowed almost full time in carrying out his duties. Repairs are made under the direction of the bridge engineer by the track, bridge or mechanical department forces, depending on their character. The special representative makes the inspection, recommends what work shall be done, makes reports to various officers, has access to all drawings and turntable records, and is authorized to order repair parts. He is also required to keep on file in the bridge engineer's office a complete list of spare parts for emergency repairs.

A schedule of inspection is prepared by the special inspector and sent to all superintendents. He then arranges to have the master carpenter, a bridge foreman and a gang on the ground on the date specified, with jacks, wrenches, waste, oil and such other tools and supplies as may be necessary. The span is then raised on the jacks and is carefully blocked for safety. The center-bearing parts are removed, cleaned and examined, after which they are put back into place, together with lubricating oil or grease. After the span has been lowered to place, a locomotive is run onto the table and the end-wheel clearances are checked. During the time when the table is being raised and lowered, the inspector examines the steel work, the timber deck, the tractor, the circle rail, the circle wall and other items.

### Depends on Service

By G. L. Staley
Bridge Engineer, Missouri-Kansas-Texas, St. Louis, Mo.

Turntables should be inspected at least once a year and more frequently if experience indicates that this is desirable. Obviously, the amount of use determines the amount of wear and tear, so that yearly inspections generally find little change where the service is light, but material changes may occur where the service is heavy. It is good practice to make routine monthly inspections without raising the table and to make such light repairs currently as become necessary on tables that are in constant use.

Annual inspections should be made jointly by representatives of the mechanical department, which uses the table; the maintenance department, which is responsible for keeping it up; and the engineering department, which

### To Be Answered in December

1. *What details should receive attention in the care of a motor car to insure the best service from it?*
2. *Can building repair work be programmed? If not, why? If so, to what extent? How is the program prepared?*
3. *What is the most satisfactory method of inspecting and controlling switch-tie renewals? How does this differ from crossties?*
4. *In what ways can electrically-operated tools be used to advantage in bridge and building work?*
5. *Under what circumstances are gage rods or gage plates necessary or preferable to double spiking on curves on main tracks? On switching tracks? How should they be installed?*
6. *What are the relative advantages and disadvantages of placing steam, air and water lines overhead and underground?*
7. *What effect, if any, do the weight of rail, the kind or amount of ballast, the condition of the roadbed and temperature have on rail creepage?*
8. *Should wood surfaces be inspected prior to painting? Why? In how much detail? Who should make the inspection?*

**Send your answers to any of the questions to the What's the Answer Editor. He will welcome also any questions you wish to have discussed.**

is responsible for its design and construction. At the annual inspection the table should be raised so that all parts can be seen. Roller bearings should be removed to expose all wearing surfaces and the rollers and wearing rings should be cleaned. Raising the table also provides a better opportunity to inspect the cross-loading girders and diaphragms. The end carriages must be observed closely, although this can be done without raising the table. All bracing between girders must be inspected in detail, as well as the track, the deck, all electrical appliances, the drainage of the pit, the circle walls, the circle rail, the foundation and the painting. The general ability of the table to perform the service required, should also be judged.

It has not yet been proved that the use of grease instead of oil for lubrication of the center bearings has made inspections at the former intervals unnecessary. In fact, in some cases, more frequent inspections have been found necessary where grease is used. Grease serves to seal the bearing chamber against the entrance of dirt and water, but will not lubricate the modern type of roller-bearing centers, or any bearings which have shafts through the rollers, or other enclosed close-fitting bearings, when lubrication must get more than an inch or two distant from the points of entrance.

For three-point bearing tables, the program of inspection should be the same as for those of the center-bearing type. Where there are removable covers on the bearings, there is no need to raise them, especially as it may be desirable not to disturb the adjustment in elevation.

### Inspections Avoid Tieups

By G. S. Crites
Division Engineer, Baltimore & Ohio, Punxsutawney, Pa.

Shallow, continuous-type turntables are fast replacing the older cantilever type in busy terminals, because they possess superior advantages for turning modern steam locomotives. Many of the center-bearing tables are still in service and must be depended on as long as they remain. Most of them are being worked to the limit. Where this is being done, especially in busy terminals, a sudden or unexpected failure will cause serious interruptions to the turning of locomotives. Reasonable inspections avoid unexpected tieups.

In busy terminals, it is desirable to give such tables a thorough inspection semi-annually. This should be done under responsible maintenance-of-way supervision, with the assistance of the roundhouse foreman and the electrical foreman. The table can be jacked up or lifted by the wrecking crane. The tractor should be set out first and turned over to the mechanics and electricians for inspection and repairs. After the table is on blocks, all parts should be cleaned and inspected and damaged or badly worn parts replaced.

A similar inspection of tables of the continuous type should be made annually, and of the cantilever type at points of light service. These inspections also include the painting, the replacement of worn parts and the repairing of structural defects.

# Causes of Rail Creepage

*What are the causes of rail creepage? Is it more pronounced on single or double track? Why?*

### Rail Does Odd Things

By H. R. Clarke
Engineer Maintenance of Way, Chicago, Burlington & Quincy, Chicago

It is dlfficult to give a definite and concise answer to this question because of the unusual way in which rail sometimes creeps. In general, rail creeps in the direction of heaviest traffic. On multiple-track lines this is in the direction of traffic, where train movements are confined largely to designated track in each direction. In the case of single track, this should be in the direction of heaviest traffic and greatest tonnage. In both cases there is a tendency for the creepage to be more pronounced down-grade than up-grade.

Where the direction of creepage is as outlined, it is generally agreed that the causes are:

1. Impact of the wheels on the end of the receiving rail, tending to drive the rail forward.
2. Wave motion of the rail ahead of the advancing wheels. A tendency of this motion is to lift the track from its bed and force it forward in the direction of traffic.
3. The tendency to drag the rail forward when brakes are set. Naturally, this is increased in the direction of descending grades, which accounts for the increased tendency of the rail to creep in the direction of traffic and down grade.

Generally, rail creepage is more pronounced on double than on single track, principally for the reason that traffic on each track is directional. On double track, aside from reversal of traffic, a practice that is followed quite generally on some roads, and to a limited extent on others, the traffic is in one direction on each track. On single track the traffic is more or less evenly divided, but this division will depend on the direction of greatest traffic density.

The foregoing sets out what I believe are generally accepted as the principal causes of rail creepage. As suggested in the beginning, however, there are times when rail movement cannot be explained in this way. For instance, rail occasionally creeps against traffic, and in other cases the movement is up grade instead of down grade. So far as I know, no satisfactory explanation of this behavior has been advanced or met with general acceptance. Even more puzzling, perhaps, is the situation occasionally encountered, in which one rail remains stationary while the other creeps. Even more strange are those occasions when one rail creeps in one direction and the other one creeps in the opposite direction.

All of these unusual conditions occur, I believe, on practically every railway, and maintenance officers have devoted a great deal of time and effort to find the cause of such behavior. It has been suggested that the location of turnouts which permit freer movement of one rail than the other might be the answer to the problem of why rails creep in opposite directions. This may be the explanation, and it is as reasonable as any I have heard advanced; yet the fact that rail creepage in opposite directions frequently occurs at some distance from any turnout and a similar movement may not be observed closer to the turnout, raises a doubt as to the reasonableness of this explanation.

### Much Study Has Been Given

By W. H. Sparks
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

This subject has been under study for many years, and various theories concerning rail creepage have been advanced. Yet no satisfactory conclusion has been reached with respect to some of its phases, and I fear that the correct answers to some of the problems

connected with the inconsistencies of rail behavior are far in the future. It has happened more than once that a theory that seemed to cover all possible causes has been shattered by the fact that rail, somewhere, was acting in a fashion completely at variance with the facts upon which the theory was based. In other words, it is probable that there are several causes; that sometimes they act singly, in which event the explanation seems simple; and that at other times several of them act together, producing rather odd results that are not easily explained.

It has been observed that rail creepage is usually more pronounced where the roadbed crosses a swamp for a considerable distance, this being attributed to the yielding of the soil upon which the roadbed rests, In general, rail creepage is in the direction of traffic, and this fact is the basis for the belief that it results in large part, if not wholly, from the wave motion of the rail ahead of the advancing wheels, but there are so many exceptions to this directional movement as to lead to the belief that this is only one cause, which may not be as important relatively as we have assumed. More than one case has been recorded where one rail has moved with traffic while the other remained stationary or crept in the opposite direction. A few cases have been observed where both rails have crept against traffic, on tracks upon which there was no reversal of train movement.

Rail shows a marked tendency to creep down grade, but any theory concerning the influence of gravity or braking is complicated by the fact that a few miles farther ahead, there may be a gradient upon which the rail is traveling uphill under identical conditions of traffic and, seemingly, of physical conditions. Again, situations have been noted where one rail is moving downhill while the opposite rail moves uphill.

For several years we have noted that on double track the rail under the left side of the locomotive shows a greater tendency to creep than that under the right side. So far, we have been unable to find any reasonable explanation for this behavior, but it is too widespread and consistent not to be the result of a specific cause or combination of causes.

Is rail creepage more pronounced on single or on double track? In general, it is more pronounced on double track where the traffic is directional. It is also more noticeable on the track that carries the heaviest tonnage, which seems to confirm the theory that it results from wave motion. On single track, traffic moves in both directions and under this theory, where it is approximately balanced, there should be no creepage. The fact remains, however, that creepage does occur and that the same inconsistencies with respect to rail movement, are found on single track as on double track.

Why? This part of the question, like that relating directly to the causes of rail creepage, must remain unanswered until we learn more about why rail movement is subject to so many inconsistencies. Seemingly, the same cause cannot be operating where the creepage is reversed to traffic as when the movement is with traffic. Again, we must find what force retards one rail when they creep in the same direction, but at different rates, and why one rail remains stationary while the opposite one creeps.

Rail creepage is of sufficient importance to warrant more intensive study than it has received heretofore. If it were not for anti-creepers it would be of still greater importance. Many of us assumed that the heavy rail sections in common use today would eliminate the trouble, but despite heavy rail and other improvements in track construction, it is still a matter of concern.

# Constructing Wood Crossings

*When constructing a wood crossing, is it desirable to provide an air space below the planks? Why? How can this be done?*

## May Be Advantageous

By Thomas Walker
Roadmaster, Louisville & Nashville, Evansville, Ind.

I am unable to speak from experience, for I have never constructed a wood crossing; however, I believe that an air space under a solidly-planked crossing will be advantageous, but the crossing should be well drained so that water will not stand under the planks. An air space will permit the use of thinner planks, which will promote economy, but the main advantage will be to avoid the possibility of the planks heaving in freezing weather. The air space can be provided easily by placing furring strips on top of the ties to raise the planks above the ties.

## Considers It Desirable

By E. L. Banion
Roadmaster, Atchison, Topeka & Santa Fe, Marceline, Mo.

An air space under crossing timbers is desirable for several reasons, the principal one of which is to keep the area under the crossing plank as dry as practicable. Dirt and mud carried onto the crossing by vehicles tend to foul the ballast and create poor drainage, so that the crossing may remain wet for a long time after a rain. An air space under the plank will assist in drying out the moisture. With the heavier rail sections, it is good practice to use either four or five-inch plank placed on furring strips to obtain the desired height. This will not only provide an air space under the plank between adjacent ties, but also reduces the amount of lumber necessary to insure a solid crossing.

Considerable trouble has been experienced with the outside plank on these crossings, as they tend to heave, particularly where gravel, crushed stone or other loose material is used outside the plank. Highway traffic crowds and packs this material into the air space under the plank, causing it to heave. Similar action by car and locomotive wheels forces dirt and gravel through the flangeway openings and under the inside plank. The first condition can be relieved by setting a plank on edge and fastening it to the outer plank to box the air space. The second condition has been improved by using wood flangeway strips to prevent foreign matter from getting through the flangeway.

When placing a surface crossing, the air space should be of secondary importance, since the installation must be judged primarily on its smoothness and traction, and on its ability to retain its fixed position under high-speed trains and under the hazard from dragging equipment catching under the planks and tearing them out, with the incidental possibility of derailment.

It is my observation that the necessary air space can be obtained by means of specially-framed furring on each tie, fastened to the ties independently of the fastenings for the plank. Sawn, rather than hewn, ties should be used, since this will provide a more even surface and avoid the necessity for framing the treated ties or furring strips in the field.

To insure the maximum service

from wooden crossings and to afford the maximum of safety, the plank should be fixed rigidly to the ties to prevent relative motion between them. To meet these requirements, the ends of the planks must not project beyond the side of the tie, but must be flush with it. Each plank should be fastened to alternate ties, with double fastenings at each end. These fastenings should be ⅜-in. by 10-in. or ⅝-in. by 12 or 14-in. boat spikes, or lag screws of the same length. They should penetrate the tie from 5 to 7 in., depending on the height of the rail and the soundness of the ties supporting the plank. It is my experience that lag screws are preferable in gum or other woods that tend to warp after they are installed.

To insure easy removal of the lag screws when taking up the crossing for any reason, it is well to use washers under the screw heads. The holes should be countersunk and tar or some sealing compound should be poured to fill the counter-sunk holes after the screws are in place.

### Crossings Last Longer

By J. E. Watson
Assistant Foreman, Chicago, Burlington & Quincy, Galesburg, Ill.

Where there are wide extremes of temperature, a wood crossing will last longer if an air space is left under the planks, for, as freezing and thawing occur, the ballast tends to heave and force the planks up if they are in contact with it. That is, if the thickness of the plank and the height of the rail are the same, and the ballast is flush with the tops of the ties, the planks will be affected by the slightest expansion of the ballast.

A successful method of preventing this action is to dress the ballast through the crossing about three inches below the top of the ties. If a liberal application of asphalt is then made over the ballast, and care is exercised to seal all openings, water, which causes most of the trouble at crossings, will be excluded. Furring strips of proper thickness on the ties and a wood strip to fill the flangeway should then be applied. The furring strips serve a dual purpose—they increase the air space and reduce the thickness of the plank, allowing planks two to four inches thick to be used, depending on the importance of the crossing and the character of the highway traffic. A thin coating of tar on the surface of the crossing will seal the crevices between the planks and reduce the amount of water passing through the crossing. The flangeway filler excludes mud and other material from the air space.

If the highway is not paved, a plank set edgewise against the outside plank of the crossing will box in the air space and exclude dirt and gravel. It will also prevent the heaving of the outside plank. This is not necessary on a paved road.

# Inspecting Ballast-Deck Trestles

*What details should be given particular attention when inspecting a ballast-deck trestle? When should the inspection be made? Who should make it?*

### By Divison Inspector

By W. C. Harman
Supervisor of Bridges and Buildings, Southern Pacific, San Francisco, Cal.

The inspection of ballast-deck trestles should be made by the division bridge inspector at the time of his regular inspection of the bridges, trestles and culverts on the division. It is best, however, to make the inspections at a time when there is little or no water in the stream, so that the bents shall be exposed more completely.

On approaching a trestle, it will be well to observe the line and surface of the track, for they frequently provide the first evidence of a weakened bent caused by defective caps, settling piles or other conditions. When the water is low the inspector can investigate more easily the action of the water around the bents and learn whether scour has occurred.

Beginning with the pile supports, the details of the inspection should include prodding or boring untreated piles for decay between the ground line and a point 3 ft. below the surface. Here will be found the first decay in the pile, and a further examination of the points of contact with the bracing may reveal other areas of infection. Piles and other timbers should be examined for termite infestation. The presence of these insects can usually be detected by pinholes in the sides of the piles or by deposits of pellets on or near the timber. Next, the piles should be checked for settlement by sighting or, in some instances, by noting if any are down from the caps. High piles will be observed to have punched into the cap, and they should be cut to line. Caps should fit neatly to the piles so that the bearing is equal at all points. It should be noted whether all bolts are in place and well tightened.

Decay in untreated caps is generally found in the upper half and particularly at the stringer seats, usually as a result of water entering some opening in the top of the stick or seeping in between the stringers and the cap. Excessive decay can be detected by sounding with a hammer and, in many instances, by the bulging of the sides of the timber, by spreading of the top or by crushing over the piles.

Untreated stringers must be watched closely. However, they are seldom used unless well protected with paint or when covered by composition roofing or metal sheets. Decay or termites may attack them and the inspector should examine the tops and abutting ends closely. Broken stringers usually are caused by improper framing which has left some stringers deeper than others, with consequent overloading. Creosoted stringers give little clue to defects which may be developing on the interior, but certain signs known to the experienced inspector, such as bulging sides or fanned-out tops, give an indication of approaching failure and a rap with a hammer and the peculiar dead sound complete the story.

### Like the One Horse Shay

By S. F. Grear
Assistant Engineer of Bridges, Illinois Central, Chicago

A well designed ballast-deck trestle resembles the one horse shay, in that all parts are equally strong and about equally vulnerable. If any one part requires particular attention, and should, therefore, be excepted from this statement, it is the cap. These are large timbers—we use 14-in. by 14-in. caps — and they are subject to checking and splitting. During the inspection, every cap should be examined at each end and at the bottom, to detect any evidence of decay. A cap that shows signs of bulging in the sides, is decayed inside the treated zone and should be replaced at once. The unit bearing of the cap on the piles or posts is heavy and each cap should be inspected on the underside to determine whether this high pressure is causing them to "punch" into the cap or causing breaking fibres.

Stringers should be inspected for splits and breaks. If splits are found, they must be examined to determine

whether they are deep enough or are so located that they cause appreciable weakness. While my experience indicates that there is likely to be very little decay in creosoted stringers, no chances should be taken, and sufficient examination should be made at the supports and along the tops to determine whether decay is present. About two years ago we found stringers in two adjacent bridges with sufficient decay to require renewal. These stringers were only about twenty years old, and presumably had not been treated properly.

Some trouble has been experienced from carpenter ants working in caps and stringers, and any cuttings or what appears to be sawdust on the ground provides an indication that they are at work. These large ants, which are quite destructive to wood, enter the timber through cracks and holes in the treated wood and eat the untreated material beneath the zone of treatment.

If not protected properly, creosoted piles will decay inside the treated shell, and piles 15 years old, or older, should be sounded for hollowness. This heart decay almost always starts at the top of the pile, but sometimes at a bolt hole or a check. For this reason the sounding should cover the entire length of the exposed part of the pile. In many cases, piles must be bored to determine the thickness of the treated shell.

Floor boards and braces are very little subject to rot, and visual inspection is sufficient. Guard timbers are particularly subject to splitting and subsequent decay. They are especially likely to rot at the bolt holes. Visual inspection is usually sufficient for the hardware, but occasional bolts should be tried with a hammer to determine tightness.

In addition to the foregoing details, a general examination of the structure should be made to determine whether piles have settled, whether scour has occurred around bents or bulkheads, whether vegetation should be removed, whether there is drift against or near the bridge and whether water barrels need filling.

District bridge foremen should inspect all of their bridges once a month, or more often if there is any known defect. The supervisor or master carpenter should see them four times a year and a whole-line or system inspector should examine all bridges once a year and be in position to pass on repairs or renewals.

The time for making the inspection will depend on the location of the structure. The annual inspection should be completed by October, so that the reports will be available for preparing the budget for the following year. January, February and March are too rainy to insure proper inspection, for there is apt to be too much water under the bridges. It is essential to get on the ground under ballast-deck trestles if one is to make a satisfactory examination.

### Miss No Detail

By G. W. Benson
Supervisor Bridges and Buildings, Central of Georgia, Macon, Ga.

Since every detail of a ballast-deck bridge is important, none should be overlooked. The inspection should include the line and surface of both track and trestle; the condition of the piles, braces, caps, stringers, flooring, guard rails and headwalls. All timbers should be examined by sounding and, where doubt exists, by boring, the latter applying particularly to piles, caps and stringers. Floor boards, headwalls and guard rails should be examined for any conditions that might lead to loss of ballast. Ties should be examined with the same care as the trestle itself. The ballast should be examined to determine whether it is tamped properly under the ties and for drainage. Fire walls, metal guards and other fire protection should be examined. The stream bed should be examined for channel changes and scour.

The inspection should be made during the dry season, for a reliable inspection cannot be made when the water is high. The inspection should be made by the supervisor jointly with the district bridge foreman. All details should be recorded on a special inspection form. This report provides a record for future inspection by the division engineer or a representative of the chief engineer and as a guide for ordering repair materials.

# What Kind of Pump?

*What are the relative advantages and disadvantages of centrifugal and displacement pumps? Does the service in which they are used make any difference?*

### Power, not Service, Governs

By G. S. Crites
Division Engineer, Baltimore & Ohio, Punxsutawney, Pa.

Centrifugal pumps give a steady continuous flow, but unlike displacement pumps are not adapted for service where intermittent changes in pressure and flow occur. The service for which pumps are used governs the type of pump that will be most satisfactory, but the kind of power available must also be given consideration. Centrifugal pumps can be connected directly to electric motors, steam turbines or high-speed internal-combustion engines, with each of which they combine in compact units. The working parts are few and the pipe connections are simple. By adding one or more stages, high pressure may be developed. A single-stage centrifugal pump will work against heads up to 150 ft. without undue pressure on the bearings.

Displacement pumps handle gases better than centrifugal pumps, by compressing them to any desired limit in controlled stages, whereas centrifugal pumps hardly more than augment the flow of the gases. For handling liquids, displacement pumps must work rather slowly to avoid churning or having energy dissipated by the inertia of the liquid. Gears are used to attach pumps of this type to motors, turbines or fast-revolving engines, which adds to wearing and breaking parts.

Steam has had a long start over electricity and internal-combustion engines for operating pumps, but steam, unless used in turbines, is not adapted for centrifugal pumps. For this reason, in many installations, power and not service will be the governing factor in the selection of pumps.

### Advantages Defined

By Supervisor of Water Service

Centrifugal pumps have the advantage of lower cost than displacement pumps of the same capacity, while maintenance is generally lower. They can be operated without attendance, which is usually impracticable with displacement pumps. They require far less floor space than displacement pumps of equal capacity, so that pump houses can be smaller. They are adapted particularly for handling muddy waters or those containing sand. Starting valves, relief vales and air cushions on discharge lines and vacuum chambers on suction lines are unnecessary.

Centrifugal pumps give a steady

continuous discharge, free from pulsations, and do not, therefore, cause water hammer in discharge lines. Again, failure to open a valve or the sudden closing of a valve in the discharge line has no effect on the pump. Centrifugal pumps are adapted particularly for operation by electric motors, making automatic operation feasible.

On the other hand, they cannot make as great a suction lift as a displacement pump and will not operate if only a slight amount of air leaks into the suction line. They require a reasonably constant head for most efficient operation, so that they are not well adapted for service where there are large fluctuations in the head. Likewise, since any material reduction in the head increases the amount of water pumped, they may overload and burn out the motor, if they are operated by electric power.

Displacement pumps can be operated successfully and without detriment to the equipment, under wide variations in head and volume of water pumped. They will handle higher suction lifts and are not affected by small air leakage into the suction line. They are not well adapted for electrical operation, and, in general, require an attendant when in use.

# Length of Guard Rails

*What are the relative merits of long and short guard rails opposite frogs on tangent running tracks? On curves? On the turnout side?*

## Should Be Short

By H. F. Fifield
Engineer Maintenance of Way, Boston & Maine, Boston, Mass.

A guard rail of sufficient parallel length should be provided to cover the throat of the frog and extend from 6 to 12 in. back of the point, this length depending on the number of the frog. Spring-rail frogs should have guard rails on the turnout side that are long enough to cover the movable spring rail. The parallel portion should be set from 6 in. to 1 ft. back of the frog, depending on the kind and number of the frog.

Any guard rail longer than is necessary to protect the point or spring rail, with sufficient added length to provide a flare of about 3 in. at each end, increases the cost unnecessarily and, as I see it, cannot be justified. The foregoing applies to connections and curves, as well as tangents, so far as the protection of the frog is concerned. On curves on high-speed track, a longer guard rail is desirable in some cases to straighten the truck before it reaches the throat of the frog, to avoid lurch and improve the riding of coaches.

## Recommends 11 Feet

By W. H. Sparks
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

Heavier rails, guard-rail clamps, better designs for frogs and generally stronger track have changed the requirements for guard rails, from those which were considered necessary with the lighter rail sections. On tangents there is no reason why an 11-ft. guard rail cannot be used safely on the running track, provided clamps are employed, end lugs are in position and bolted, and the track is maintained to gage. On the turnout side, where traffic is diverted to another running track, to a siding or to a spur, and where speeds are relatively high, the 16½-ft. guard rail will be better, since it will straighten the trucks and hold them in line, as well as guide the wheels past the point of the frog.

Modern locomotives have long wheel bases and some of them are relatively stiff. It is my observation that a longer guard rail on the turnout side will catch the engine-truck wheels far enough ahead of the frog point to pull them over and keep them away from the point, thus reducing wear on the point. It will do the same for the driving wheels and will straighten the trucks of the following cars. To insure this performance, however, guard-rail clamps and bolted end blocks should be installed, so that the guard rail will be held rigidly to the running rail. In yard tracks, the speed is much lower than on main tracks and the 11-ft. guard rail will be satisfactory for both the through route and on the turnout side.

# Capacity of a Septic Tank

*How should the capacity of a septic tank be determined? Does this differ for stations, shops, offices and company dwellings? If so, in what way?*

## Depends on Type of Use

By Frank R. Judd
Engineer of Buildings, Illinois Central, Chicago

Capacities for septic tanks are determined by the number of persons to be served and the time required for sedimentation. Consideration must also be given to the type of use, that is, whether it is to be more or less continuous, as in homes, hotels and institutions, or non-continuous, as in schools, factories, office buildings, etc. As a rule, the capacity should vary from 3 cu. ft. per person for large installations serving 500 persons, to 15 cu. ft. per person for small tanks serving 5 persons. The reason for this is that longer periods of detention are required for sedimentation in the smaller tanks because of the greater fluctuation of flow. Septic tanks for schools or factories, where the use is more or less non-continuous, will serve about twice as many persons as those for homes, hotels or institutions, where the use is continuous.

There are a number of different makes of septic tanks on the market, which are built up of standard units to provide various capacities. These are used for dwelling and small-station installations. For shops, where large capacities are required, the tanks should be designed for each individual installation and constructed of concrete as a permanent facility.

## On a Per Capita Basis

By General Inspector of Buildings

Many mistakes have been made in the design of septic tanks, the most common of which are small capacity and failure to provide for proper flow through the tank. A capacity that is too small to allow a sufficient period for the complete nitrification of the organic wastes in the sewage will defeat the entire purpose of the septic tank, and any arrangement for flow that permits solids to get into the effluent will be equally unsatisfactory. It has been my observation that it is

better to make a liberal allowance when calculating the capacity of the tank and that the cost of a little excess capacity over calculated actual needs represents money well spent.

I recall the case of a septic tank that was installed to serve a new shop and engine terminal, the effluent from which was discharged into a small swamp adjacent to the shop grounds. To reduce the cost, the designer limited the capacity to the minimum he considered necessary to serve the force he was told would man the new facility. As a matter of fact, the tank was too small to give satisfacory results from the start, and when the force was increased only slightly early in the summer the swamp became so offensive that it was necessary to enlarge the septic tank at an overall cost greatly in excess of what it would have cost to construct a tank of the same capacity in the first place, according to a consistent plan.

Calculations of capacity should be based on the number of persons to be served, with a reasonable allowance for increases. The per capita requirements, however, should follow a sliding scale, being greater for small installations than for larger ones. Some difference should also be made between facilities that are to be used continuously and those that are for intermittent service. This latter refers particularly to offices where only a day force is worked. It is never safe to calculate the size of a septic tank for a shop on the basis of intermittent use, for if it is designed for a day force only, it will not function satisfactorily if a second shift is employed later, and conditions will be still worse in the event a third shift is employed, even if only temporarily.

A general rule followed by many designers is to allow 3 cu. ft. per person served for capacities to care for 400 to 500 persons, if the use is continuous. I prefer to make this a minimum of 3½ cu. ft. for 500 or more persons. This capacity is then increased proportionally to, say, 15 cu. ft. for small groups, such as families occupying section houses or other company dwellings, where not more than 4 or 5 persons are to be served. I prefer to make this 20 cu. ft. Intermediate sizes can be determined graphically by drawing a straight line between the maximum and minimum capacities. If it is certain that the facility will be used intermittently, the per capita requirements may be reduced by one-third.

# What Is the Maximum Lift?

*What is the maximum lift that can be tamped effectively with power tamping tools? The minimum lift? Does the kind of ballast make any difference?*

## Depends on Ballast

By L. J. Drumeller
Engineer of Track, Chesapeake & Ohio, Richmond, Va.

The maximum and minimum lifts that can be tamped effectively with power tamping tools depends in large measure on the size of the ballast. It is readily apparent that 2-in. ballast should not be used when making a raise of 1 or 1½ in. since the ballast must be broken into smaller sizes or the tie bed will be badly disturbed in the process, either of which will have an adverse effect on future maintenance. When the size of the ballast exceeds the lift by any appreciable amount, it will result in pulverizing the ballast, since it is desirable to operate the tampers simultaneously on opposite faces of the tie that is being tamped. Ballast thus pulverized will result in pumping track, thereby increasing future maintenance costs. Furthermore, where the ballast exceeds materially the amount of the raise, the tie beds will either be broken up or small humps will appear in the surface. It has been observed on several occasions that, where this has been done, when the tampers reach a set of track jacks they are "tamped off" and it becomes unnecessary to trip the jacks to remove them from the track.

It is my observation that a lift greater than 3½ in. should not be tamped with power tools, but that the track should be raised in two lifts, and the first one tamped with either forks or shovels, using shovels for gravel and forks for stone. The final raise should then be tamped with power tools.

A lift of ½ in. should be the minimum and the size of the ballast should be reduced accordingly. Any track that requires a raise of only ½ in. needs only to be smoothed by correcting the line and cross level. Any attempt to work lifts less than ½ in. out of face with power tools will result in distortion of the surface, pulverized ballast and badly broken tie beds.

Generally, the kind of ballast will make little difference with respect to maximum or minimum raise, so far as power tamping is concerned, and the foregoing discussion applies to both stone and gravel, except that when making two lifts on gravel the first one is usually shovel-tamped on four faces and traffic is allowed to settle the track uniformly.

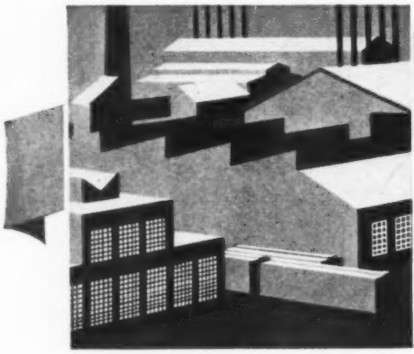
## Four Inches the Limit

By District Engineer

The maximum lift that can be tamped mechanically will depend in large measure on the type of tamping tool and the kind of ballast. It is possible to tamp a 4-in. raise on gravel ballast with a vibrating tool and obtain excellent results, although I prefer to limit the raise to 3 in., for it is my experience that less settlement will occur and the work of the follow-up gang will be reduced accordingly. If the lift is to be greater than 4 in. the track should be raised in two lifts, and the first one should be tamped with shovels. The first raise should be made so that after settlement occurs, the final lift will be about 2 in. Where this is done and sufficient time is allowed for thorough compacting by traffic, the track will remain in surface much longer than if only one lift is made. Depending somewhat on the quality of the gravel, I would limit the lift to 2 in. if percussion tampers are to be employed.

I have never employed the vibrating type of tamping tool in stone ballast, but I consider 3 in. as the maximum lift on this ballast for satisfactory work with the percussion type. I am aware that many maintenance officers approve greater lifts, but my observation leads to the belief that this is a mistake. As with gravel, a raise on stone greater than 3 in. should be made in two lifts, the first one being tamped with forks.

In general, the kind of ballast has little to do with the minimum lift, assuming that the tamping is to be done mechanically. The important factor in this case is the disturbance of the tie bed, so that the size of the ballast is far more important than the kind of ballast. In hand tamping, the larger sizes can be discarded; but this is not practicable in power tamping. For this reason, the minimum raise should be only slightly less than the nominal size of the ballast; otherwise, the tie bed will be destroyed or the larger pieces of ballast will be pulverized, both of which are highly undesirable. The only alternative to the latter result will be humped track, which is equally undesirable.



# PRODUCTS of Manufacturers

## New Buda Inspection Motor Car

A NEW one- or two-man light inspection motor car, Model F-1, has been placed on the market by the Buda Company, Harvey, Ill. The new car, which has been named the Buda Buddy, has been designed especially for use by track inspectors, supervisors, signal men, roadway foremen and others. Safe and economical operation, roominess and easy riding are said to be among the car's principal merits.

The car has an electrically-welded all-steel frame and is powered with a four-cycle, 7.7-hp. Briggs and Stratton gasoline engine. Power is transmitted to the drive axle by means of a roller chain controlled by a heavy-duty friction drive with a spring-loaded clutch. Both forward and reverse operation are provided. The axles are precision-machined from S.A.E. 1045 cold rolled steel on which are mounted 14-in. diameter insulated wheels with pressed steel rim tires and haskelite centers.

The front axle is of the Buda patented ball bearing differential type, which allows one wheel to turn independent of the other. The axles are mounted in rubber-cushioned ball bearings, which eliminate steel contact between the frame and the axles. Four-wheel self-centering brakes are provided with replaceable metal-faced brake shoes. Easy adjustment of the brakes is provided to compensate for wear on the brake shoes. Skid rails allow the car to be removed from the track quickly and easily and extra-long steel handles, which telescope inside the frame of the car when not in use, are provided for lifting one end of the car. Although the car weighs 535 lb., the lifting effort required at the ends of the handles is only 95 lb.

The overall length of the car is 68 in. and the wheel base is 35 in. It is available with one or two seats and with such standard accessories as windshield, rail sweeps, warning gong, etc. The seats face forward and are of the coil spring type, extra large, leather covered and well padded. A high reinforced steel back adds to the operator's safety and comfort. The car has a low center of gravity, which adds to its riding stability. All controls are placed within normal reach of the operators hand from a comfortable position in the seat. Safety hand rails at the front of the car give added protection to the operator and passengers. A tool compartment is located under the drivers seat and deck space for tools, equipment or baggage is unusually large, room being provided behind the engine and on the side for the complete length of the car. The Buda Model F-1 is also available for special gage tracks.

**The Buda Model F-1 Was Designed Especially As a One- or Two-Man Light Inspection Car for Track Inspectors, Supervisors, Etc.**

## New Cab Top for Section Motor Cars

A NEW cab top has been developed by Fairmont Railway Motors, Inc., Fairmont, Minn., for installation on section motor cars, which is designed to protect the men from cold, sleet, snow, raw winds and other disagreeable weather. The cab is constructed of welded frame sections with sides of 26-gauge sheet steel. Good visibility is provided by large shatterproof glass windows, which are mounted in rubber to prevent rain from being driven through the joints and to cushion them from shocks and vibration. The top is made of a solid sheet of waterproofed plywood covered with heavy, white duck canvas which is painted and treated to make it waterproof. Additional protection for the section men can be obtained by the installation of side and rear curtains that may be drawn back and fastened to the corner posts when not needed. The

**Section Motor Car Equipped With the Cab Top**

new cab tops can be easily applied in the field to Fairmont S2 series E, and S2 series F section cars.

## Off-Track Power Mowing Machine

THE Moto-Mower Company, Chicago, has developed a one-man heavy-duty power mower for railroad work known as the National Railroad Special, which is adapted for heavy mowing in rough ground, on banks, or in other difficult places and, it is claimed, will mow as much or more than seven men with scythes.

Side View of the National Railroad Special, Equipped With a Weed Deflector Bar

The mower has an all-steel frame, electrically welded into one unit, mounted on two pneumatic tires equipped with puncture-proof tubes. At the front of the mower, a 40-in. horizontal heavy-duty sickle is mounted on the ends of two projecting steel outriggers. Two handle bars, which extend toward the back of the machine are provided for its operation, and the motor and sickle controls are conveniently located at the handles. The mower weighs approximately 250 lb. and has a clearance of 18 in. below the motor-carrying frame.

Power is provided by a four-cycle Briggs and Stratton gasoline motor which is mounted in the center of the unit above the wheels, providing a balance which, it is said, makes the mower easy to operate and maneuver. An automobile-type differential gives equal power to both wheels. The sickle bar is driven by a counter-balanced Pittman drive connected to the power source by high-quality roller-type chains and it is said to be easily removable. The sickle can be disengaged so that it does not move between cuttings and is protected by a patented deflector bar designed to prevent clogging in heavy or high vegetation and to make the vegetation pass under the machine. All bearings are of high grade bronze and are provided with an alemite lubrication system.

It is said that this mower is light and easy to operate, yet is ruggedly constructed; that it can be operated in many places that heavy mowers cannot go; that it will cut anything that any power mower will cut; that it has few wearing parts and that it is economical to operate and maintain. For winter use in snow removal work, the mower may be equipped with a snow plow attachment 18 in. high and 48 in. wide which is attached at an angle by means of two brackets, one short and the other long. The brackets are fastened to the mower frame by U-bolts provided with the plow. The snow plow can be used as a bulldozer for cleaning grade crossings by using two short brackets of equal length in place of one short and one long, as used for the snow plow attachment.

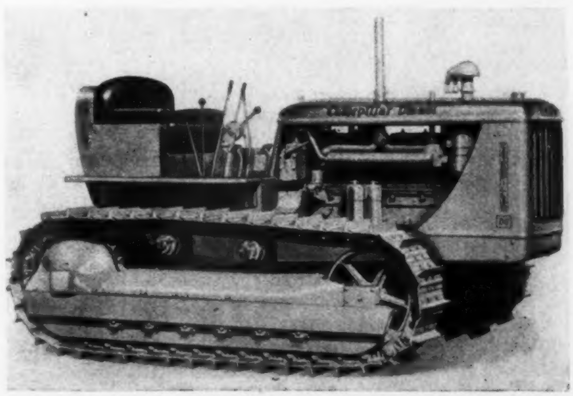
## New Caterpillar Tractor

A 55-HP. Diesel tractor, known as the Caterpillar D6, designed by the Caterpillar Tractor Company, Peoria, Ill., for greater capacity and speed with lower operating costs, is adapted for many types of off-track maintenance work. The D6 has an overall length of 12 ft. 5 3/16 in. and a height of 6 ft. ½ in. It is manufactured in two gage widths, 74in. and 60 in. With the 74 in. gage, it has an overall width of 7 ft. 10¼ in., and weighs 16,500 lbs., with the 60 in. gage it has an overall width of 6 ft. 8¼ in. and weighs 16,300 lb. It has five forward speeds ranging from 1.4 m.p.h. to 5.8 m.p.h., and for each of the first four forward speeds there is a corresponding, but slightly higher reverse speed. It can be reversed simply by pushing or pulling a single lever.

The tractor is driven by a 6-cylinder, 4-cycle, water-cooled engine, which develops 55 drawbar horsepower and 65 belt horsepower. The engine has a rated speed of 1,400 r.p.m. at full load and has a full pressure lubrication system. It is mounted on a welded steel frame, which, with the steering clutch case, is welded into one unit. The power is transmitted through a dry flywheel clutch with metallic friction surfaces, a flexible coupling, and carburized gears. An independent 2-cylinder, 4-cycle gasoline engine with a high tension magneto is provided for starting the engine.

The entire tractor is said to be designed for speed, flexibility and ease of operation. A wide seat, with a back rest and liberal foot room, is provided for the driver. Although the tractor weighs more than eight tons, it is said to steer as easily as an automobile. When only 14 lbs. of pull are exerted on the steering levers, a separate control unit does the work by hydraulic pressue. It is said that few points on the D6 require regular servicing, and these only at infrequent intervals. The tractor is designed for accessibility to its working parts and is constructed with quality materials throughout. Cylinder liners, crankshaft journals and many other parts are given a "Hi-Electro" induction hardening treatment.

A spark ignition tractor of the same horsepower and size with a 6-cylinder gasoline engine, designated as the R6, has also been developed.



The Caterpillar D6 55-H.P. Diesel Tractor Is Designed for Greater Capacity and Speed With Lower Operating Costs

# NEWS of the Month

### Railroad Employment Continues to Gain

Railroad employment increased from 1,187,205 to 1,207,569, during the one-month period from mid-July to mid-August, while the August total was 13.92 per cent above that for August, 1940, according to a compilation of the Interstate Commerce Commission based on preliminary reports. August employment in all groups was above that of the previous month and of the corresponding month last year. The largest increase was in the maintenance of way and structures group, with a 3.42 per cent increase as compared to July of this year, and a 17.35 per cent rise as compared to August, 1940.

### Southern Pacific Denied Right to Import Mexican Laborers

The Southern Pacific and agricultural interests in Arizona have been denied authority by the Immigration Bureau of the Department of Justice to bring a large number of Mexican laborers into the United States. The Southern Pacific had asked to bring in some 600 Mexican laborers who would be employed in maintenance-of-way work on its lines in the southwest, where there now exists a shortage of labor. No specific reason was given for the refusal, but it is known that the railway labor organizations and the Mexican Government had objected.

### Ralph Budd—No Shortage If Shippers Do Their Duty

In a letter to A. W. Vogtle of Birmingham, Ala., president of the National Association of Advisory Boards, and J. E. Bryan of Chicago, president of the National Industrial Traffic League, dated September 11, Ralph Budd, defense transportation commissioner, discussed the coming fall peak of carloadings, "which, if weekly carloadings follow the usual pattern in rising to the fall peak, and especially in view of the diversion of freight from other carriers to the rails, may be between 975,000 and 1,000,000 cars." He went on to refer again to the scarcity of materials needed to fill railroad orders for new equipment, saying: "On August 15, 1941, there were 1,589,203 railroad-owned serviceable freight cars, an increase of 163,383 over the number available on September 1, 1939. Inability to obtain necessary material in recent months, however, has resulted in the car-building program lagging to the extent that by October 1, 1941, there will be 20,000 less new cars in service than were provided for by the railroads."

Thus, as Mr. Budd puts it, "we must make better use of the existing cars"; and he points out how "the important part which shippers and receivers play in efficient utilization of freight cars has long been recognized. During the next several weeks in order that everyone desiring transportation service may receive it currently without delay, new records in the volume of transportation rendered per unit of serviceable equipment must be made. This appeal to all users of transportation to renew during the coming weeks their previous efforts to eliminate all wasteful use of transportation, and particularly to urge all to do everything in their power to prevent delay to cars while awaiting loading or unloading is made in the interest of the general welfare. A few hours and a few dollars spent in loading or unloading cars seven days a week or after usual closing time may well pay large dividends to the shippers directly involved, and to the country as a whole."

### Priority Control Revised Again

A seven-member Supply Priorities and Allocations Board, designed to assure "unity of policy and coordinated consideration of all relevant factors involved in the supply and allocation of materials and commodities among the various phases of the defense program and competing civilian demands," was created on August 28 by President Roosevelt. The new board—SPAB—is headed by Vice-President Wallace, with Donald M. Nelson, who has been head of OPM's Purchases division, as executive director. The other five members are: Secretary of War Stimson, Secretary of the Navy Knox, Director General Knudsen and Associate Director General Hillman of the Office of Production Management, Price Administrator Henderson, and Harry L. Hopkins, special assistant to the President supervising the lend-lease program. Mr. Nelson will also serve as director of OPM's Priorities Division, succeeding E. R. Stettinius, Jr., who has been appointed lend-lease administrator. The new set up is expected to eliminate difficulties which have arisen as a result of the overlapping jurisdictions of OPM and the Office of Price Administration and Civilian Supply. OPACS now becomes the Office of Price Administration and its civilian supply activities are transferred to OPM, where Mr. Henderson will head a new Civilian Allocations division, the function of which will be "to initiate plans and programs for civilian allocations, which will be submitted through the Office of Production Management to the new board of seven for final approval or amendment."

### Wage Negotiations Fail Emergency Board Appointed

After holding meetings from August 14 to September 5, the National Mediation Board announced that efforts to mediate the wage increase and other issues, which were reported in the Septembr issue, had failed. On September 5 the 14 non-operating brotherhoods set September 11 as the date for a strike and on September 9, the five operating brotherhoods announced that a strike of employees in train, engine and yard service on one-third of the major railroads would become effective on September 15, on another third on September 16, and on the final third on September 17. The President, on September 10, appointed a five-man Emergency Board, as provided by Section 10 of the Railway Labor Act, "to investigate the report respecting such dispute." By the terms of the Act, the strikes were thereby deferred for 60 days, 30 days being allowed the Board to study facts concerning the dispute and report to the President and 30 more before a strike may be placed in effect. The Board, however, reported to the President that it could not complete the hearings and make a report by October 10, and asked that the time limit be extended to November 1, which request has been granted. Under the procedure outlined by the Board, formal hearings were begun on September 16 and will be closed on October 18. The brotherhoods will be allowed 12 days and the railways 15 days in which to present their evidence.

The members of the five-man Emergency Board appointed by the President are: Wayne Lyman Morse, dean of the law school of the University of Oregon, who will act as chairman; Thomas Reed Powell, professor of law at the Harvard Law School; James Cummings Bonbright, professor of finance at Columbia University; Joseph Henry Willits, director for social science of the Rockefeller Foundation; and Huston Thompson, Washington, D.C., attorney and former member of the Federal Trade Commission.

# Personal Mention

## General

**G. M. Helmig,** roadmaster on the Missouri Pacific at Marquette, Kan., has been promoted to master of trains and track for the Missouri-Illinois (Missouri Pacific subsidiary) west of the Mississippi river, with headquarters at Bonne Terre, Mo.

**G. J. Nash,** assistant trainmaster on the Illinois Central at Markham yard (Chicago), and an engineer by training and experience, has been promoted to trainmaster, with headquarters at Hawthorne, Ill. Mr. Nash was born at Two Rivers, Wis., and graduated from the Milwaukee State Teachers College, Milwaukee, Wis., and studied engineering at the University of Wisconsin. He was principal of a school at Wausau, Wis., for two years, and worked in the engineering department of the Pullman Company at Chicago during the summer of 1917. On October 14, 1917, he entered railway service as a chainman on construction for the Illinois Central at Clexton, Ky. He was later promoted successively to rodman and instrumentman and on November 1, 1925, he was advanced to assistant engineer at East St. Louis, Ill. On September 1, 1926, he was transferred to the office of the engineer maintenance of way at Chicago and on January 1, 1929, he was advanced to track supervisor on the Chicago terminal. Mr. Nash later served as a rodman, track supervisor at Rockford, Ill., and assistant trainmaster at Markham yard.

**I. A. Moore,** supervisor of bridges and buildings on the Chicago & Eastern Illinois at Danville, Ill., has been promoted to trainmaster, with headquarters at Salem, Ill.

I. A. Moore

Mr. Moore was born at Dearborn, Mo., on April 14, 1896, and after attending the University of Missouri for two years, served with the A. E. F. as a lieutenant of engineers in France, returning to this country in 1919. He later took a correspondence course, graduating in civil engineering and also became a registered structural engineer in Illinois. He entered railway service on November 15, 1920, as an assistant on the engineering corps of the C. & E. I. at Evansville, Ind., later serving in that capacity successively at Salem, Evansville and Danville. On May 16, 1933, he was appointed bridge inspector and in December, 1933, he was advanced to supervisor ot bridges and buildings, with headquarters at Danville, the position he held until his recent promotion. Mr. Moore has been an active member of the American Railway Bridge and Building Association for several years, serving at present as a member of the board of directors of that association.

**Frank Gordon Cook,** assistant superintendent on the Idaho division of the Northern Pacific, with headquarters at Spokane, Wash., and an engineer by training and experience, has been promoted

Frank Gordon Cook

to superintendent of the Idaho division, with the same headquarters. Mr. Cook was born at Concord, N. H., on August 13, 1885, and graduated from Dartmouth College in 1908 and the Thayer School of Civil Engineering in 1910. He entered railway service in July, 1904, with the Boston & Maine and on May 1, 1910, he went with the Northern Pacific as a rodman at Jamestown, N. D., later being promoted to instrumentman and assistant engineer at that point. On May 1, 1915, he was appointed roadmaster at Mandan, N. D., later being transferred to Helena, Mont. Mr. Cook was advanced to division roadmaster, with headquarters at Glendive, Mont., on January 1, 1927, and on May 1, 1929, he was promoted to trainmaster-roadmaster on the Rock Mountain division. On February 1, 1935, he was appointed trainmaster at Auburn, Wash., and on June 1, 1937, he was promoted to assistant superintendent.

**Robert M. Blaydes,** roadmaster on the Kansas City Southern at Shreveport, La., has been promoted to trainmaster, with the same headquarters. Mr. Blaydes was born in 1896 and entered railway service on August 25, 1913, as a roadmaster's clerk on the Kansas City Southern at Texarkana, Ark. After various promotions, he was advanced to roadmaster, with headquarters at Texarkana on

March 1, 1926, and on August 16, 1932, he was transferred to Shreveport. With the exception of a short period as assistant trainmaster in 1934, Mr. Blaydes continued as roadmaster at Shreveport until his recent promotion, September 8.

## Engineering

**David F. Apple,** acting division engineer of the Cincinnati division of the Chesapeake & Ohio, with headquarters at Covington, Ky., has been promoted to division engineer, with the same headquarters.

**J. W. Dudgeon** has been appointed chief engineer of the Great Western Railway, with headquarters at Loveland, Colo., succeeding **James Sykes,** whose death on August 30 is reported elsewhere in these columns.

**V. C. Hanna,** resident engineer on the Gulf, Mobile & Ohio at Meridian, Miss., has been appointed assistant engineer in charge of construction of the Terminal Railroad Association of St. Louis, with headquarters at St. Louis, Mo.

**A. E. Korsell,** assistant engineer on the Chicago, Rock Island & Pacific at Chicago, has been appointed engineer of grade crossings, with the same headquarters, a newly created position.

**H. E. McGee** has been appointed assistant engineer on the New York Central system (Big Four) at Anderson, Ind., succeeding **N. L. Arbuckle,** whose death on August 29 is reported elsewhere in these columns.

**A. F. Ewert,** transportation inspector on the Atchison, Topeka & Santa Fe at Arkansas City, Kan., has been promoted to division engineer of the Oklahoma division, with the same headquarters, succeeding **K. W. Claybaugh,** who has been assigned to other duties.

**Loyd T. Casson,** resident engineer of the Terminal Railroad Association of St. Louis, has been promoted to bridge engineer, with headquarters as before at St. Louis, Mo., succeeding **Walter L. Smith,** who retired on September 1, and **Newel J. Law, Jr.,** assistant engineer, has been appointed assistant bridge engineer.

**Everett E. Earl,** acting division engineer on the Southern Pacific, with headquarters at Los Angeles, Cal., has been promoted to division engineer of the San Joaquin division, with headquarters at Bakersfield, Cal., succeeding **L. E. Peterson,** who has been transferred to the Los Angeles division, with headquarters at Los Angeles, relieving **H. E. Stansbury,** who has been appointed assistant engineer at San Francisco, Cal.

**Alexander J. Barclay,** location division engineer on the Southern Pacific Lines, retired on June 30. Mr. Barclay entered Southern Pacific service in May, 1892, as an instrumentman-draftsman on the Coast division and was later appointed assistant engineer on the construction of various lines in Southern California. From 1924 to 1925 he served as engineer in charge of reconstruction work in the vicinity of Reno, Nev., and Carlin and was then appointed consulting engineer for the law department. From 1927 to 1933 he served

as construction division engineer in charge of new main line construction at Klamath Falls, Ore., and Phoenix, Ariz. He then served until 1940 as construction engineer on the Los Angeles Union Passenger Terminal.

**Joe Edward Wheeler,** whose promotion to assistant division engineer on the Southern Pacific at Tucson, Ariz., was reported in the August issue, was born at Ellis, Kan., on December 12, 1902, and attended the University of Kansas. He entered railway service in September, 1922, as a flagman on a location survey for the Kansas City Southern and in April, 1923, he went with the Southern Pacific as a rodman on construction at Mojave, Cal. Five months later he was transferred to the maintenance department at Bakersfield, and later served as draftsman, instrumentman, assistant engineer and, at various times, general foreman and acting roadmaster in the track department. Mr. Wheeler was serving as acting roadmaster at Tehachapi, Cal., at the time of his recent promotion.

**H. R. Miles,** whose retirement as division engineer on the Canadian Pacific, with headquarters at Moose Jaw, Sask., was reported in the September issue, was born at Winnipeg, Man., on March 14, 1879, and entered railway service in 1899 on location work on the Washington County Railway (now part of the Maine Central). In 1900 he went with the Algoma Central & Hudson Bay on location and construction and in July, 1901, he went with the Canadian Pacific as an assistant engineer, later serving as a resident engineer, maintenance of way, on the Lake Superior division. On July 1, 1915, he was appointed assistant engineer at Montreal, Que., and on January 15, 1919, he was promoted to division engineer at Lethbridge, Alta. Mr. Miles was transferred to Moose Jaw on November 6, 1933, where he remained until his retirement on July 1.

**E. C. Haynie,** whose promotion to assistant division engineer on the Louisville & Nashville, with headquarters at Birmingham, Ala., was reported in the September issue, was born in Lee County, Ala., on November 30, 1883, and graduated from Alabama Polytechnic Institute, Auburn, Ala. He entered railway service in June, 1906, as a rodman on the Alabama Great Southern (part of the Southern system), and later served as an instrumentman and resident engineer. In October, 1910, he went witn the L. & N. as an instrumentman and in December, 1912, he was promoted to assistant engineer at Louisville, Ky. In November, 1921, he was appointed office supervisor and in the latter part of 1923 he was promoted to roadmaster, with headquarters at Anniston, Ala. When this position was abolished in July, 1931, Mr. Haynie was appointed supervisor of track, with the same headquarters, the position he held until his recent promotion.

**Carl H. Vogt,** supervisor of track on the Central of New Jersey, whose promotion to assistant division engineer of the Central division, with headquarters at Jersey City, N. J., was announced in the August issue, was born on March 16, 1888, and obtained his higher education at Lehigh university, graduating in civil engineering in 1909. He entered railway service with the New York Central in July, 1909, as a member of the engineering corps. In August of the same year he became an assistant supervisor of track and later served as an inspector at a steel mill. From January, 1914, to December, 1915, he served as an inspector at a creosoting plant. At the end of this period, Mr. Vogt became a bridge inspector, later being appointed assistant supervisor of bridges and buildings. In May, 1917, he became assistant division engineer and in January, 1923, he became supervisor of track. On February 1, 1930, he left this road to go with the Jersey Central as supervisor of track at Jersey City, which position he held until his recent promotion to assistant division engineer.

**A. T. Kinne,** whose promotion to division engineer on the Louisville & Nashville, with headquarters at Nashville, Tenn., was reported in the September issue, was born at Evansville, Ind., on November 29, 1885, and entered railway service on November 11, 1905, as a rodman on construction for the L. & N. He later became a masonry inspector for the Atlanta, Birmingham & Coast and foreman for a contracting firm. In May, 1908, he returned to the L. & N. as a rodman and in June, 1909, he was promoted to instrumentman. Mr. Kinne was advanced to assistant engineer at Evansville, Ind., in October, 1916, and in August, 1920, he was appointed headquarters supervisor. In November, 1921, he was appointed assistant engineer at Louisville, Ky. In November, 1926, he was promoted to roadmaster at Birmingham, Ala., and in August, 1935, he was advanced to assistant division engineer, with the same headquarters, the position he held until his recent promotion, effective August 1.

**A. T. Kinne**

**James A. Dyer,** whose retirement on August 1 as division engineer of the Lake Shore division of the Chicago & North Western, with headquarters at Green Bay, Wis., was reported in the September issue, was born at West Troy, N. Y., on December 20, 1875, and graduated from Rensselaer Polytechnic Institute in 1897. He entered railway service on March 9, 1899, as an instrumentman on the Iowa division of the North Western, later being promoted to assistant engineer and serving in that capacity on the Iowa, Wisconsin and Galena divisions. In March, 1906, he was promoted to assistant general bridge inspector, with headquarters at Chicago, and a year later he was appointed assistant engineer in Chicago. In April, 1909, Mr. Dyer was appointed special assistant engineer at Gillespie, Ill., and in October, 1913, he was promoted to division engineer, with headquarters at South Pekin, Ill. In October, 1919, he was transferred to Madison, Wis., and in April, 1920, he was transferred to Mason City, Iowa. He was transferred back to South Pekin five years later and on November 1, 1925, he was transferred to Green Bay, where he remained until his retirement.

**Harold C. Stull,** whose promotion to assistant division engineer on the Southern Pacific at El Paso, Tex., was reported in the August issue, was born at Bozeman, Mont., on January 2, 1886, and attended Rennsselaer Polytechnic Institute from 1905 to 1909. He first entered railway service during the summer of 1906 as a chainman on location surveys for the Chicago, Burlington & Quincy, later serving on valuation surveys for the Oregon Short Line (now part of the Union Pacific) and as an inspector and levelman on the Portland, Eugene & Eastern (now part of the Southern Pacific) at Portland, Ore. In September, 1913, he went with the Oregon-Washington Railroad & Navigation Company (now part of the Union Pacific) at La Grande as an instrumentman and extra gang foreman. Mr. Stull later engaged in work for a lumber company at Tacoma, Wash., served in the U. S. Army on the Mexican border, engaged in copper mining work in Mexico, and served as assistant county engineer at Tombstone, Ariz. In September, 1920, he became office engineer for the E. P. & S. W. at Douglas, Ariz., and in November, 1924, he was appointed assistant engineer on the Southern Pacific at El Paso, Tex. Four years later he was transferred to San Francisco, Cal., and in 1935, he was appointed office engineer at that point, the position he held until his recent appointment.

**George M. Taylor,** whose appointment as division engineer of the newly created Shasta division of the Southern Pacific, with headquarters at Dunsmuir, Cal., was reported in the August issue, was born at San Francisco, Cal., on January 28, 1884, and graduated from the University of California in 1906. In May, 1906, he entered railway service with the Southern Pacific, serving as a chainman and rodman on a location party until May, 1907, when he became a draftsman on the Northwestern Pacific (a subsidiary of the Southern Pacific). From May, 1908, to September, 1910, Mr. Taylor served as an instrumentman and draftsman on a location party for the Southern Pacific. From January, 1911, to April, 1912, he was chief of party on the the relocation of industrial tracks for a commercial concern, then returning to the Southern Pacific as an instrumentman on the Shasta division. In April, 1915, he was promoted to assistant engineer on the same division and on July 1, 1918, he was further advanced to assistant division engineer on that division. On October 1, 1932, Mr. Taylor was appointed assistant district engineer of the Shasta district of the Sacramento division and on November 22, 1937, he was advanced to district engineer,

with headquarters as before at Dunsmuir, which position he was holding at the time of his recent promotion.

**A. E. Bechtelheimer,** assistant engineer of bridges of the Chicago & North Western, has been promoted to engineer of bridges, with headquarters as before at Chicago, succeeding **Oscar F. Dalstrom,** who retired on September 1. **Arthur Raymond Harris,** office engineer at Chicago, has been advanced to assistant engineer of bridges, replacing Mr. Bechtelheimer.

A. E. Bechtelheimer

Mr. Bechtelheimer was born at Eldena, Ill., on April 4, 1881, and attended Iowa State College and the University of Wisconsin. He entered railway service in October, 1905, as a chainman on the North Western at Boone, Iowa, and in April, 1906, he was promoted to rodman. A year later he was advanced to instrumentman and from June, 1908 to February, 1910, he served as a draftsman and instrumentman. In March, 1912, he was appointed a bridge draftsman, with headquarters at Chicago, and in May, 1913, he was promoted to assistant general bridge inspector, with the same headquarters. Mr. Bechtelheimer was advanced to general bridge inspector in March, 1920, and in December, 1928, he was promoted to assistant engineer of bridges, the position he held until his recent promotion. Mr. Bechtelheimer has been active in the American Railway Bridge and Building Association for many years, and served as president of that organization in 1940.

Oscar F. Dalstrom

Mr. Dalstrom was born at Wyanet, Ill., on Augnst 15, 1871, and attended Fremont (Neb.) Normal College and Rensselaer Polytechnic Institute, graduating in civil engineering from the latter in 1901. In June, 1901, he became a draftsman in the bridge and construction department of the Pennsylvania Steel Company (now the Bethlehem Steel Company) at Steelton, Pa., later serving as a shop inspector. He then served successively as a detailer on movable bridges for the Scherzer Rolling Lift Bridge Company; detailer on steel structures for the Riverside Bridge Company at Martin's Ferry, Ohio, and detailer and checker on steel bridge plans for the Pennsylvania Steel Company. He entered railway service on June 1, 1906, as a detailer, checker and designer on plans for bridges and other structures for the North Western and four years later he was promoted to chief draftsman in the office of the engineer of bridges. On March 1, 1917, Mr. Dalstrom was promoted to engineer of bridges, the position he held until his retirement. Mr. Dalstrom has been active in the American Railway Engineering Association for many years, and at the present time is chairman of the committee on Iron and Steel Structures of that association.

Mr. Harris was born at Cameron, Mo., on April 26, 1897, and attended the University of Missouri from 1914 to 1918. He entered railway service on March 12, 1923, as a draftsman and designer for the North Western at Chicago and in 1925 he was promoted to assistant chief draftsman. Mr. Harris was advanced to office engineer in 1939, which position he held until his recent promotion.

Arthur Raymond Harris

## Track

**Hugh Price,** track supervisor on the Chicago, Rock Island & Pacific at Armourdale, Kan., has been promoted to roadmaster, with headquarters at St. Joseph, Mo., succeeding **J. H. Fenno,** who has been transferred to Dalhart, Tex., relieving **G. W. Williams,** assigned to other duties.

**R. C. Violett,** roadmaster on the Chicago, Rock Island & Pacific at Iowa City, Iowa, has been transferred to El Reno, Okla., succeeding **John W. Shurtleff,** who has been transferred to Chickasha, Okla. Mr. Shurtleff relieves **Belshur Bristow,** who has been transferred to Ft. Worth, Tex., replacing **A. B. Harrison,** who has been transferred to Iowa City, succeeding Mr. Violett.

**C. B. Weimers,** a section foreman on the Southern Pacific Lines in Texas and Louisiana, has been promoted to roadmaster, with headquarters at Edinburg, Tex., succeeding **H. E. Weatherly,** who has been transferred to San Antonio, Tex., relieving **J. C. McHaney,** who retired on August 1.

**Paul E. Lowe,** roadmaster of Division No. 1 of the Delaware, Lackawanna & Western, with headquarters at Hoboken, N. J., has been promoted, effective September 15, to general roadmaster, with headquarters at Scranton, Pa., to succeed his father, **G. E. Lowe,** engineer of track, whose death on August 23 is reported elsewhere in these columns. **Clifford Graham,** track supervisor on Division No. 5, has been promoted to roadmaster of Division No. 6, with headquarters at Syracuse, N. Y., relieving **Telle Lederman,** who has been transferred to Hoboken, replacing Mr. Lowe.

**George W. Smith,** supervisor of track on the New York Central system (Big Four) at Galion, Ohio, has been transferred to Greenville, Ohio, succeeding **C. L. Roberts,** who has retired, and **L. W. Moss,** supervisor of track on the Sandusky district, has been transferred to Galion, replacing Mr. Smith. **C. V. Talley** has been appointed supervisor of track at Anderson, Ind., relieving **H. H. Wise,** who has been granted a leave of absence because of illness. **Ira Walker** has been appointed supervisor of track at Anderson, Ind., succeeding **James P. Davis,** who retired on August 31, after 52 years service.

**Eric Joseph Erickson,** whose promotion to roadmaster on the Canadian Pacific, with headquarters at Strasbourg, Sask., was reported in the September issue, was born at Crosby, N. D., on September 5, 1903, and entered railway service on July 15, 1917, as a section man on the C. P. R. at Baliol, Sask. He later served as a section man at Colonsay, Sask., and Moose Jaw, and in 1921 he was promoted to relieving foreman. Three years later he was advanced to section foreman and in 1926 he was promoted to assistant extra gang foreman. In May, 1940, Mr. Erickson was promoted to relieving roadmaster and served in that capacity until March, 1941, and again from May, 1941, until his recent promotion.

**Paul Jones Seidel,** general yard fore-foreman on the Erie at Buffalo, N. Y., has been promoted to supervisor of track at Huntington, Ind., succeeding **A. N. Burgett,** who has retired. **John Beilby,** supervisor of track at Youngstown, Ohio, has been transferred to Warren, Ohio, replacing **R. M. Hills,** who has been transferred to Youngstown, relieving Mr. Beilby.

Mr. Seidel, was born at Milton, Pa., on October 6, 1906, and graduated in civil engineering from Bucknell University in 1929. He entered railway service in June, 1929, as an assistant on the engineering corps of the Pennsylvania at Washington, D. C., and in April, 1930, he went with the Erie at Hornell, N. Y., as chief of a curve party. In June, 1932, he was transferred to Jersey City, N. J., and in July, 1939, he was promoted to chief of corps at Dunmore, Pa. Mr. Seidel was advanced to

general yard foreman at Buffalo in August, 1941, which position he held until his recent promotion.

**Herbert Mason Curtiss,** whose promotion to supervisor of track on the Pennsylvania, with headquarters at Kalamazoo, Mich., was reported in the September issue, was born at New Haven, Conn., on August 12, 1911, and graduated in civil engineering from Norwich University in 1934. He enterer railway service on November 1, 1935, as an engineering apprentice on the Pennsylvania at Terre Haute, Ind., and on May 1, 1936, he was promoted to assistant on the engineering corps. He was later transferred successively to Toledo, Ohio, and Grand Rapids, Mich., and on July 23, 1938, he was furloughed. Mr. Curtiss was called back into service on January 16, 1939, as an assistant on the engineering corps at Columbus, Ohio, and two months later he was transferred to Piqua, Ohio. On October 1, 1939, he was promoted to main line assistant supervisor of track at Huntingdon, Pa., which position he held until his recent appointment, effective August 1.

**Daniel Quinn,** whose retirement on July 15, as roadmaster on the Denver & Rio Grande Western, with headquarters at Grand Junction, Colo., was reported in the August issue, was born at Nenagh, Tipperary, Ireland on September 15, 1871, and entered railway service in May, 1900, as a laborer on the Colorado Springs & Cripple Creek (now part of the Colorado & Southern). In 1903 he went with the Denver, Northwestern & Pacific (now the Denver & Salt Lake) as a section foreman and two years later he became an extra gang foreman on the Denver & Rio Grande Western. Mr. Quinn went with the Colorado Midland as a roadmaster in 1910 and in 1918 he returned to the D. & R. G. W. as roadmaster at Thistle, Utah, later serving at various other points and in 1924 being transferred to Grand Junction.

**Calvin J. Langenbach,** assistant supervisor of track on the Central of New Jersey, whose promotion to supervisor of track, with headquarters at Somerville, N. J., was announced in the August issue, was born on June 5, 1895. He entered railway service with the Jersey Central on January 16, 1912, as a trackman at Glen Gardner, N. J., being promoted to assistant track foreman at that point on September 1, 1914, and then to section foreman on September 1, 1916. On October 13, 1929, Mr. Langenbach was promoted to assistant supervisor of track, with headquarters at Somerville, N. J., returning to the position of section foreman at Glen Gardner on August 1, 1931. On November 1, 1934, he was promoted to assistant supervisor of track, with headquarters at Long Branch, N. J., which position he held until his recent promotion.

**Thomas Duggan,** whose retirement as roadmaster on the Southern Pacific, with headquarters at Tehachapi, Cal., was reported in the August issue, was born in Kerry County, Ireland, and attended college in that country. He entered railway service on September 29, 1908, as a section laborer and trackwalker on the Southern Pacific, at Palm Springs, Cal., and on March 1, 1909, he was promoted to assistant extra gang foreman on the Los Angeles division. A year later he was advanced to extra gang foreman and then served as extra gang and section foreman at various points on the Los Angeles and San Joaquin divisions until March 1, 1926, when he was promoted to roadmaster on the Rio Grande division, with headquarters at Bowie, Ariz. Mr. Duggan was transferred to the San Joaquin division, with headquarters at Tehachapi, in March, 1930, which position he held until his retirement.

**John M. Minturn, Jr.,** whose promotion to supervisor of track on the Pennsylvania, with headquarters at Cleveland, Ohio, was reported in the August issue, was born at Cincinnati, Ohio, on March 5, 1911, and graduated in civil engineering from the University of Cincinnati in 1934. He entered railway service on January 16, 1935, as an assistant on the engineering corps of the Pennsylvania at Ft. Wayne, Ind., and on July 1, 1936, was transferred to Columbus, Ohio. On March 10, 1937, he was promoted to assistant supervisor of track on the Delmarva division at Clayton, Del., and on May 1, 1938, he was appointed assistant on the engineering corps at Newton, Pa. Mr. Minturn was transferred to the Philadelphia Terminal division at Philadelphia, Pa., on January 19, 1939, and on February 24, 1939, he was advanced to assistant supervisor of track at that point, the position he held until his recent promotion, effective July 23.

**Charles F. Parvin,** assistant supervisor of track on the Pennsylvania, whose promotion to supervisor of track with headquarters at Enola, Pa., was noted in the August issue, was born on December 15, 1912, at Cambridge, Md. Mr. Parvin attended the University of Michigan, graduating in 1934. He entered railway service with the Pennsylvania on July 2 of that year as assistant on the engineering corps at Ft. Wayne, Ind., later serving in the same capacity at Chicago and Columbus, Ohio. In February, 1937, he was promoted to assistant supervisor of track on the Conemaugh division at Aspinwall, Pa., later being transferred to the Erie and Ashtabula division at Niles, Ohio. In May, 1938, Mr. Parvin returned to the position of assistant on the engineering corps, but was reappointed assistant supervisor of track in February, 1939, this time on the Philadelphia division at Enola. In August of the same year he was transferred to Lancaster, Pa., on the same division. He was located at this point at the time of his recent promotion to supervisor of track at Enola.

**Joseph Fielding Selby,** assistant roadmaster on the Denver & Rio Grande Western at Helper, Utah, has been promoted to roadmaster, with headquarters at Gunnison, Colo., succeeding **Eston Royse,** whose transfer to Green River, Utah, was reported in the August issue. Mr. Selby was born at Effingham, Kan., on February 1, 1905, and attended Kansas State Agricultural College in 1924 and 1925. He entered railway service on February 23, 1926, as a welder helper on the Lincoln division of the Chicago, Burlington & Quincy, and was promoted to welder on the Wyoming district in August, 1926. He was later advanced successively to district frog welder, with headquarters at Alliance, Neb., and to system welding gang foreman, with headquarters at Omaha, Neb. In May, 1936, Mr. Selby went with the D. & R. G. W. as welding foreman at Denver, Colo., and in May, 1941, he was appointed assistant extra gang foreman on the Salt Lake division. In June, 1941, he was advanced to assistant roadmaster at Helper.

**George M. Brum,** whose promotion to roadmaster on the Chicago, Rock Island & Pacific, with headquarters at Sibley, Iowa, was reported in the July issue, was born at Iowa City, Iowa, on March 22, 1896, and studied civil engineering at the State University of Iowa. He entered railway service in June, 1917, as a chainman on the Rock Island, later serving successively as rodman and instrumentman. In 1924, he was appointed a building inspector, with headquarters at Chicago, and in April, 1927, he was appointed a general foreman in the track department. Five months later he was advanced to roadmaster at Shawnee, Okla., later being transferred to Enid, Okla. In March, 1933, he was appointed a track inspector at Enid and in January, 1936, he was advanced to roadmaster, with headquarters at Haileyville, Okla. In July, 1938, Mr. Brum was appointed inspector in charge of the removal of the Ardmore (Okla.) branch line and in January, 1941, he was appointed a track supervisor on the Oklahoma division, which position he held until his recent promotion.

## Bridge and Building

**Lora Sullivan,** bridge and building foreman on the Illinois Central at Carbondale, Ill., has been promoted to supervisor of bridges and buildings, with the same headquarters, a newly created position.

**Paul E. Strate,** master carpenter on the Chicago, Rock Island & Pacific at Rock Island, Ill., has been promoted to acting supervisor of bridges on the Lines East of the Missouri river and the Western division, with the same headquarters, succeeding **Sam P. Perkins,** who has been granted a leave of absence because of illness. **N. F. Kincaid,** bridge and building foreman on the Western division, has been promoted to acting master carpenter at Rock Island, relieving Mr. Strate.

**Robert C. Baker,** assistant engineer on the Chicago division of the Chicago & Eastern Illinois, with headquarters at Danville, Ill., has been promoted to supervisor of bridges and buildings, with the same headquarters, succeeding **I. A. Moore,** whose promotion to trainmaster at Salem, Ill., is reported elsewhere in these columns. **B. J. Chamberlain,** on the engineering corps at Danville, has been promoted to supervisor of scales, with the same headquarters, succeeding **L. M. Gardner,** who has been appointed assistant engineer at Danville.

Mr. Baker was born at Greenfield, Ind., on January 19, 1903, and graduated in civil engineering from Evansville (Ind.) College in August, 1927. He first entered railway service in December, 1925, on the C. & E. I. and later served intermittently with that road while attending college. On March 1, 1928, he began continuous service with the C. & E. I., as an assistant on the engineering corps at Danville, three years later being transferred to Salem. On April 1, 1933, he was appointed bridge inspector at Salem and on May 1, 1936, he returned to Danville as an assistant on the engineering

(Continued on page 734)

corps. Mr. Baker was promoted to supervisor of scales, with headquarters at Danville, on December 1, 1937, and on February 7, 1941, he was advanced to assistant engineer on the Chicago division, which position he held until his recent promotion.

**Lee R. McAllister,** whose promotion to supervisor of bridges and buildings on the Southern Pacific, with headquarters at Los Angeles, Cal., was reported in the August issue, was born in Hubbard, Tex., on June 18, 1887, and attended the University of Oklahoma for one year. He entered railway service in June, 1909, on the Panhandle division of the Chicago, Rock Island & Pacific and in 1911 went with the Western Pacific on tunnel work. In 1913 he went with the Southern Pacific at Sacramento, Cal., as a carpenter, later being promoted to assistant forman. In 1919 Mr. McAllister was promoted to bridge and building foreman and in 1926 he was advanced to division bridge inspector. In 1931 he was promoted to general inspector of bridges, with headquarters as before at Sacramento, and in 1933 he was appointed bridge and building supervisor of the San Diego & Arizona Eastern (controlled by the Southern Pacific), with headquarters at San Diego, Cal. In 1935 he returned to the Southern Pacific as assistant supervisor of bridges and buildings at Portland, Ore.

### Special

**J. N. Todd,** superintendent of scales of the Southern, with headquarters as Washington, D. C., effective September 1, has had his duties extended to include maintenance-of-way work equipment with the title of superintendent of scales and work equipment, with the same headquarters.

### Obituary

**N. L. Arbuckle,** assistant engineer on the New York Central system (Big Four) at Anderson, Ind., died on August 29.

**G. E. Lowe,** engineer of track of the Delaware, Lackawanna & Western, with headquarters at Scranton, Pa., died on August 23.

**James Sykes,** chief engineer of the Great Western Railway, with headquarters at Loveland, Colo., died at his home there on August 30.

**Joseph A. Parant,** assistant to the chief engineer of the Boston & Maine, with headquarters at Boston, Mass., died suddenly on September 22 at Wolfeboro, N.H.

**Charles C. Clark,** who retired in January, 1939, as roadmaster on the Salt Lake division of the Southern Pacific, with headquarters at Ogden, Utah, died on July 3.

**George B. Loughnane,** who retired on May 1, 1930, as division engineer on the Chicago & North Western at Escanaba, Mich., died in Chicago on August 25.

**Julius F. Larson,** who retired on May 1, 1941, as roadmaster on the Hastings and Dakota division of the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Glencoe, Minn., died at his home in that city on August 20 after a short illness. A biography of Mr. Larson was published in the August issue, page 561.

# Association News

## Maintenance of Way Club of Chicago

The first fall meeting of the club will be held on Monday, October 27, in the Ambassador room of Huyler's restaurant in the Straus building, 310 So. Michigan Ave., Chicago. Dinner will be served at 6:30 p.m., followed by a program which promises to be of unusual interest.

## Bridge and Building Supply Men's Association

Auguring a highly constructive exhibit, 28 companies have already arranged to participate in the exhibition of bridge, building and water service materials and equipment to be presented by the association in conjunction with the annual convention of the American Railway Bridge and Building Association at the Hotel Stevens, Chicago, October 14-16. This already represents four more companies than exhibited last year, and other applications for space are expected. Further applications should be addressed to R. Y. Barham, secretary, Bridge and Building Supply Men's Association, care of Armco Railroad Sales Company, Inc., 310 So. Michigan avenue, Chicago. The companies that have arranged to participate in the exhibit to date include the following:

Air Reduction Sales Company, New York
American Lumber & Treating Co., Chicago
Armco Railroad Sales Co., Inc., Middletown, Ohio
Buda Company, Harvey, Ill.
Byers Company, A. M., Pittsburgh, Pa.
Celotex Company, Chicago
Chicago Pneumatic Tool Company, New York
Dearborn Chemical Company, Chicago
Paul Dickinson, Inc., Chicago
Joseph Dixon Crucible Co., Jersey City, N. J.
Duff-Norton Manufacturing Company, Pittsburgh, Pa.
Johns-Manville Corporation, New York
Koppers Company (Wood Preserving Division), Pittsburgh, Pa.
Lehon Company, Chicago
Mall Tool Company, Chicago
Massey Concrete Products Company, Chicago
Master Builders Company, Cleveland, Ohio
National Lead Company, New York
Oxweld Railroad Service Company, New York
Patterson-Sargent Company, Cleveland, Ohio
*Railway Engineering and Maintenance*, Chicago
Sherwin-Williams Company, Cleveland, Ohio
Snow Construction Company, T. W., Chicago
Stanley Works, The, New Britain, Conn.
Timber Engineering Company, Washington, D.C.
U. S. Wind Engine & Pump Co., Batavia, Ill.
Wailes Dove-Hermiston Corporation, Westfield, N. J.
Warren Tool Corporation, Warren, Ohio

## American Railway Engineering Association

Four of the standing committees of the association plan meetings during October, all concurrent with the annual convention of the American Railway Bridge and Building Association, in Chicago, to afford members of the committees opportunity to attend sessions of the convention and to visit the exhibit of the Bridge and Building Supply Men's Association to be held in conjunction therewith. These committees are: Wood Preservation, on October 14 and 15; Buildings, October 14 and 15; Wood Bridges and Trestles, October 15; and Iron and Steel Structures, October 16 and 17.

On October 21, at a public ceremony at which it is hoped many members of the association will attend, the association will present a tablet to the University of Illinois in recognition of Dr. A. N. Talbot's 27 years service as chairman of the association's Committee on Stresses in Railroad Track. The ceremony will include a luncheon at the University's Union Building, at Urbana, Ill., and the presentation, which will be made on the part of the association by F. L. C. Bond, vice-president and general manager of the Central region of the Canadian National, and president of the association, and H. R. Safford, executive assistant, Missouri Pacific Lines, and a past president of the association, will be made at 4 p.m.

Eleven committees met during September, six in conjunction with the Roadmasters' convention. The committees which met during the month included the following: Uniform General Contract Forms, at New York, on September 8; Highways, at Chicago, on September 16; Economics of Railway Labor, at Chicago, on September 16; Maintenance of Way Work Equipment, at Chicago, on September 16 and 17; Rail, at Chicago, on September 17; Track, at Chicago, on September 18; Waterways and Harbors, at Chicago, on September 23; Economics of Railway Location and Operation, at Chicago, on September 24 and 25; Water Service, Fire Protection and Sanitation, at Chicago, on September 25; and Yards and Terminals, at Richmond, Va., on September 29 and 30.

## Bridge and Building Association

With a program keyed specifically to the problems confronting bridge, building and water service men in these days, the American Railway Bridge and Building Association will hold its forty-eighth annual convention at the Hotel Stevens, Chicago, on October 14-16. In keeping with the objective of a "brass tacks" convention, the convention will remain in session until late Thursday afternoon, foregoing an inspection trip which has been a feature on the closing afternoon of the meeting in previous years. The program follows:

**Tuesday, October 14**

**Morning Session—10:00 A. M.**

Convention called to order.

Opening address by M. J. Gormley, executive assistant, Association of American Railroads, Washington, D. C., on The Tasks That Lie Ahead of Us.

Greetings from the American Railway Engineering Association, F. L. C. Bond (vice-president and general manager, C. N. R., Toronto, Ont.), President.

Greetings from the Roadmasters' and Maintenance of Way Associataion, A. B. Hillman (engineer maintenance of way, C. & W. I.-Belt Railway of Chicago), President.

Greetings from the Bridge and Building Supply Men's Association, C. C. Rausch (Dearborn Chemical Co., Chicago), President.

Address by President H. M. Church (general supervisor bridges and buildings, C. & O., Richmond, Va.).

Appointment of special committees.

Report of Committee on The Protection of Bridges and Roadway from River Bank Erosion; A. B. Chapman, chairman (office engineer, C. M. St. P. & P., Chicago).

(Continued on page 736)

**Afternoon Session—2:00 P. M.**

*Labor in a Period of Defense Activity*

Report of Committee on The Possibilities of Off-Track Equipment in Bridge Construction and Maintenance; H. T. Livingston, chairman (engineer bridges, C. R. I. & P., Chicago).

Address on Maintaining Forces in a Period of Widespread Demand for Skilled Labor, by P. O. Ferris, chief engineer, D. & H., Albany, N.Y.

Report of Committee on The Maintenance and Repair of Bridge and Building Equipment; Martin Meyer, chairman (supervisor bridges and buildings, C. & W. I., Chicago).

Adjourn at 4:00 p.m. to study exhibit of bridge, building and water service materials presented by the Bridge and Building Supply Men's Association.

**Evening Session—8:00 P. M.**

*Celebrating the Association's Golden Anniversary*

Address on A Half Century's Achievements, by Clarence R. Knowles (superintendent water service, I. C. System, Chicago), Past President.

Moving pictures of the failure of the Tacoma Narrows Bridge, presented by Alfred Herz, advisory engineer, Public Service Company of Northern Illinois.

**Wednesday, October 15**

**Morning Session—10:00 A. M.**

*Buildings for a Streamlined Era*

Report of Committee on Modernizing Small Stations to Meet Present-Day Requirements; L. C. Winkelhaus, chairman (architectural engineer, C. & N. W., Chicago).

Address on Railway Buildings in a Changing Age, by A. O. Lagerstrom, architect, C. M. St. P. & P., Chicago.

Report of Committee on Wearing Surfaces for Buildings, Floors, Platforms and Roadways; E. L. Rankin, chairman (architect, G. C. & S. F., Galveston, Tex.).

**Luncheon—12:15 P. M.**

Address on The Protection of Railroad Structures Against Sabotage, by E. P. Coffey, chief of technical laboratory, Federal Bureau of Investigation, Washington, D.C.

**Afternoon Session—2:00 P. M.**

*Materials in a Period of National Defense*

Address on What We Are Facing, by E. C. Smith, vice-president, purchases and stores, N.Y.N.H. & H., New Haven, Conn.

Address on What We Can Do, by G. A. Haggander, assistant chief engineer, C.B. & Q., Chicago.

Adjourn at 4:00 p.m. to study exhibit of bridge, building and water service materials presented by the Bridge and Building Supply Men's Association.

**Wednesday Evening—7:00 P. M.**

Annual dinner, jointly with the Bridge and Building Supply Men's Association.

**Thursday, October 16**

**Morning Session—9:00 A. M.**

*Water Service in an Era of Change*

Report of Committee on Welding in Water Service; J. P. Hanley, chairman (water service inspector, I.C. system, Chicago).

Address on Modernizing Water Service Facilities to Meet Modern Operating Conditions, by A. E. Pierce, engineer water supply, Sou., Washington, D.C.

Report of Committee on Efficient Methods of Transporting Bridge and Building and Water Service Gangs; S. S. Long, chairman (division engineer, C. & N. W., Escanaba, Mich.).

**Afternoon Session—2:00 P. M.**

Report of Committee on Recent Developments in Paint Removal; C. M. Burpee, chairman (managing editor, *Railway Engineering and Maintenance Cyclopedia,* Chicago).

Summing Up, by Armstrong Chinn., chief engineer, Alton, Chicago.

Business Session.

(All sessions on Chicago Daylight Saving Time, one hour faster than Central Standard Time.)

# Supply Trade News

## General

**The United States Wind Engine & Pump Co., Batavia, Ill.,** has been sold to a Chicago syndicate represented by F. Joseph Clark, vice-president of the Interstate Machinery Corporation, Chicago, and Mr. Clark has been elected president of the United States Wind Engine & Pump Co., succeeding **Channing Turner.**

**The Frog, Switch & Manufacturing Co.** has discontinued its New York office at 30 Church St., where the company had been represented by **Walter H. Allen.** Mr. Allen will continue his business at the same address as manufacturers' representative for railroad and contractors supplies.

## Personal

**Eugene Harbeck,** for a number of years assistant district manager at Chicago for the Armco Railroad Sales Co., Middletown,

Eugene Harbeck

Ohio, has been appointed district sales manager of the Track Spring Washer division of **The National Lock Washer Company,** Newark, N. J., with headquarters at Chicago. Mr. Harbeck was born in Chicago on April 4, 1899, attended Grand View Normal Institute, and graduated in mechanical engineering from the University of Michigan in 1922.

**Louis B. Neumiller,** vice-president of the Caterpillar Tractor Company, Peoria, Ill., has been elected president, with headquarters as before at Peoria, succeeding **B. C. Heacock,** who has been elected chairman of the executive board, relieving **R. F. Force,** resigned.

**Howard J. Mullin,** assistant to the manager of sales for the **Carnegie-Illinois Steel Corporation** at Kansas City, Kan., has been appointed assistant to the manager of sales (Pittsburgh, Pa.), with headquarters at Detroit, Mich. **Paul F. Vander Lippe** has been appointed assistant to the manager of sales in charge of the Kansas City, Kan., office, succeeding Mr. Mullin.

## Obituary

**Charles H. Roberts,** treasurer of the **Johns-Manville Corporation,** died September 10, at Doctors Hospital, New York. He was 51 years of age.

**John Morse,** assistant manager of the San Francisco, Cal., branch of **Fairbanks, Morse & Co.,** Chicago, was killed on August 22, when the automobile in which he was a passenger collided with a bus on the approach of the Golden Gate bridge during a fog.

## Trade Publications

**Portable Air Compressors.**—Schramm, Inc., West Chester, Pa., has issued a four-page folder depicting the use of its portable compressors in construction work. The folder is profusely illustrated and is attractively printed in color.

**Waterproofing Cements.**—An illustrated folder has been issued by the Smooth-On Manufacturing Company, Jersey City, N.J., which describes how the Smooth-On cements manufactured by this company can be used for waterproofing, dust-proofing and patching concrete walls and floors.

**Electrode Selector Chart**—The Air Reduction Sales Company, New York, has published an electrode selector chart for the use of arc welding operators. The chart lists separately the suggested type of electrode, welding procedure and recommended voltage for each type of metal to be welded. It is arranged for easy reference and can be hung on the welding machine or on an adjacent wall.

**American Locomotive Cranes.**—An attractive and unusually well illustrated loose-leaf catalog, 600-L-1A, has been published by the American Hoist & Derrick Company, St. Paul, Minn., providing a complete and graphic presentation of the entire line of American locomotive cranes manufactured by this company. The catalog explains the construction and operating features of these cranes and also presents tables of specifications and safe lifting capacities for the various models. In addition to being attractively printed in color, the catalog contains numerous photographic illustrations of construction features, and of many types of work being performed by American locomotive cranes.

# DON'T Pull Your Ties!

## It Takes Time—It Costs Money


SAVES 12c A TIE

# WOOLERY Cuts Them Into

## 3 EASY-TO-HANDLE PIECES

*Pulling* ties is just as difficult a job as pulling teeth—and there *is* an easier, faster way that's cheaper, too, and does a better job.

That's the Woolery Tie Cutter way. See (right) how it simplifies the work of replacing ties.

Looking ahead to next year's problems and the probable shortage of labor, you'll be glad to have the labor-saving assistance of this outstanding device. With it, renewals per man have been increased to 15-18 ties a day; with it, renewal time has been cut a third; with it, cost is reduced by 30% and more.

Here is one place to anticipate 1942's demands. Plan to get your tie renewals done faster, completed earlier, by including Woolery Tie Cutters in your program. These machines will pay for themselves twice over in one season.

Instead of laboriously digging out the crib beside the tie, jacking up the track and then pulling and hauling away at the tie (requiring two and sometimes three men for a stubborn tie), you wheel up the Woolery Tie Cutter, slice through the tie inside each rail (25-30 seconds per cut) and easily bar loose and lift out the three pieces.

***It's faster, easier, cheaper!***

**WOOLERY MACHINE COMPANY**

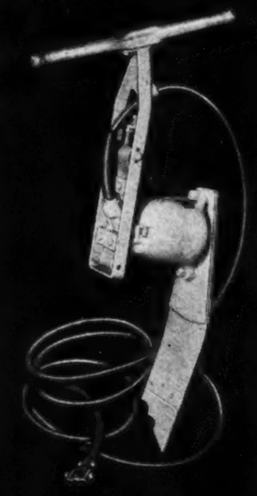
MINNEAPOLIS — Pioneer Manufacturers of — MINNESOTA

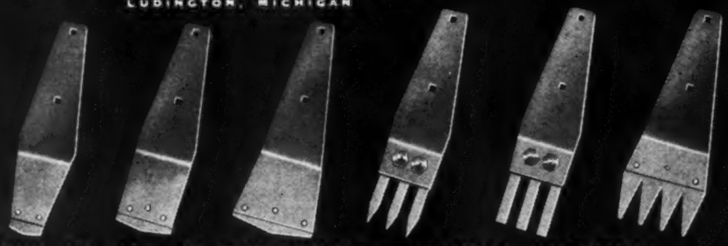
RAILWAY MAINTENANCE EQUIPMENT

TIE CUTTERS • SWITCH HEATERS • MOTOR CARS

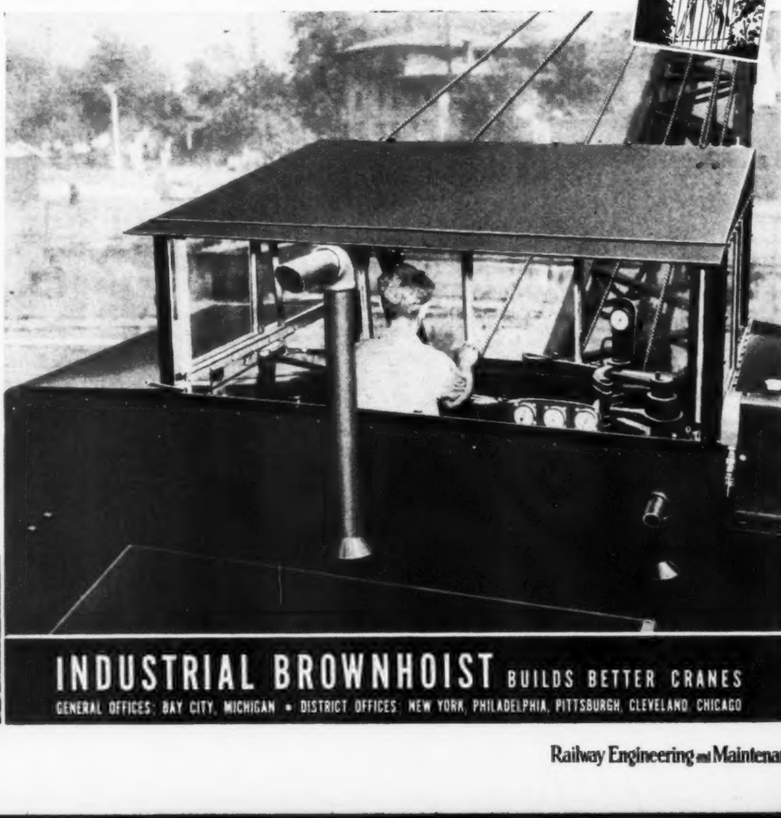
RAILWAY WEED BURNERS • BOLT TIGHTENERS

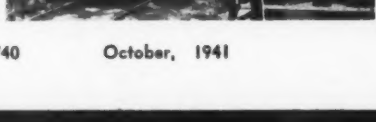












# SAVE STEEL

## For National Defense

Ardco Automatic Rail and Flange Lubricator

## with ARDCO

## Rail and Flange Lubricators

THE "Ardco" model is operated by the recurrent wheel depression of a drive spring, thereby causing grease to flow from precisely positioned ports—so located that grease contacts the flange of each passing wheel—thus efficiently lubricating both flange and rail as the curve is traversed.

The "Sesmo" type is similarly effective. This lubricator, however, is actuated by rail wave motion and is not dependent upon wheel impact.

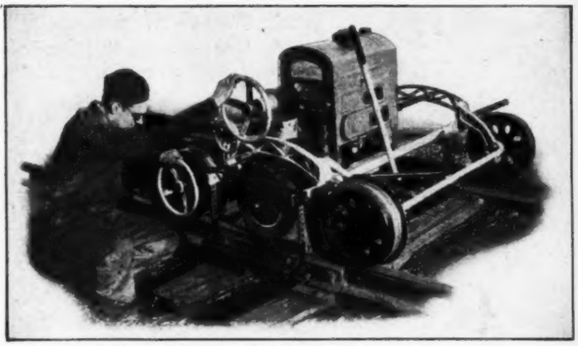
Both "Ardco" and "Sesmo" lubricators greatly prolong the life of curve rails—tire turning is minimized—curve resistance is reduced—safety is increased—and steel is saved!

**ARDCO MANUFACTURING COMPANY**
1116-1118 Paterson Plank Road — N. Bergen, N. J.

Sesmo Automatic Rail and Flange Lubricator

# "KEEP 'EM ROLLING"

● **Urgent defense demands require more freight, more speed, more cars,—more wear and tear on rails—greater need than ever for the fast, efficient maintenance job done by Railway Track-work Grinders. Prompt attention to worn frogs, switches and crossings, to battered ends, to corrugation saves time and money later. Accurate and economical, Railway Track-work Grinders help "Keep 'em Rolling" on the Nation's leading roads. Models for every requirement described in latest data bulletins.**



*Model P-22 Railway Track-work Grinder—one of many models.*

**Railway Trackwork Co.**
**3132-48 East Thompson St., Philadelphia**

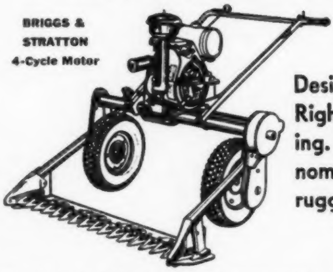
740

# REDUCE MOWING COSTS

with the

## NATIONAL RAILROAD SPECIAL

### 40" Heavy Duty Sickle Bar Power Mower




Designed for railroad Right-Of-Way mowing. Efficient and economical due to simple, rugged construction.

See it at the Roadmasters Convention at Stevens Hotel, September 15th to 18th, at Booth No. 47.

Snow Blade attachment for cleaning snow from Platforms, Walks and Driveways at slight additional cost.

**WRITE L. C. MESKIMEN FOR FULL PARTICULARS**
*Exclusive Railroad Distributor*

**The Moto-Mower Co.**
TRADE MARK

1045 Washington Blvd., — Chicago, Ill.

# ALPHABETICAL INDEX TO ADVERTISERS

## and list of their products


**Air Reduction Sales Co.** .......... 659
60 East 42nd St., New York, N.Y.
Oxygen; Acetylene; Acetylene Generators; Arc Welders; Argon; Atmospheric Gases; Carbide; Apparatus for Flame Cleaning, Dehydrating, Descaling, Deseaming, Desurfacing, Hardening, Machining and Softening, Rail End Welding; Neon; Nitrogen; Carbon Dioxide; Dry-Ice; Gas and Electric Welding Rods and Supplies; Mechanical Gas Cutting Machines; Welding and Cutting Apparatus; Rare Gases.

**American Brake Shoe & Foundry Co., The** .......... 658
See Ramapo Ajax Division.

**Ardco Manufacturing Co.** .......... 743
1116 Paterson Plank Road, North Bergen, N.J.
Rail and Flange Lubricators.

**Barco Manufacturing Company** .......... 671
1805 W. Winnemac Ave., Chicago, Illinois.
Gasoline Hammers; Tie Tampers.

**Bethlehem Steel Company** .......... 645
Bethlehem, Pennsylvania.
Bridges, all kinds; Compromise Joints; Flangeway Guards; Frogs; Gage Rods; Guard Rails; Guard Rail Clamps; Heat Treated Rail Crossings; Heel Blocks; Insulated Rail Joints; Manganese Track Work; Mayari Steel Frog, Track and Fitting-up Bolts; Nuts; Rail Braces; Rail Anchors; Rail Joints; Rails, Girder and Tee; Rivets; Spikes; Steel Plates and Shapes; Steel Ties; Steel Frame Trestles, Viaducts, etc.; Structural Steel; Switches; Switch Heaters; Switch Stands and Fixtures; Tie Plates.

**Buda Company** .......... 745
Harvey, Illinois.
Track Supplies; Diesel and Gasoline Motor Cars; Earth Drill; Hand and Push Cars; Lifting Jacks; Track Drills; Wheels; Rail Benders; Tool Grinders; Crossing Gates; Tie Tampers; Tie Pullers; Wrecking Frogs; Frogs and Switches; Gauges and Levels; Track Liners; Generator Sets.

**Carnegie-Illinois Steel Corporation** .......... 735
Carnegie Building, 434 5th Avenue, Pittsburgh, Pennsylvania.
See U. S. Steel Corporation Subsidiaries.

**Collins Oil & Manufacturing Co.** .......... 750
90 West Street, New York City.
Emulsified Asphalts for All Industrial and Railroad Requirements.

**Columbia Steel Company** .......... 735
Russ Building, San Francisco, California.
See U. S. Steel Corporation Subsidiaries.

**Cullen-Friestedt Company** .......... 743
1301 So. Kilbourn Ave., Chicago, Ill.
Anti-Slip Rail Tongs; Buckets, Clamshell; Cranes; Car Pullers; Derrick Cars; Rail Layers; Welding Positioners.

**Douglas Fir Plywood Association** .......... 660
Tacoma Building, Tacoma Washington.
Plywood, Various Grades.

**Eaton Manufacturing Company** .......... 644
(Reliance Spring Washer Division) Massilon, Ohio.
Lock Washers; Nut Locks; Spring Washers; Taper Pins; Woodruff Keys; Machine Keys.

**Elastic Rail Spike Corporation** .......... 648
420 Lexington Avenue, New York City.
Rail Spikes; Spikes, Rail.

**Electric Tamper & Equipment Co.** .......... 740
Ludington, Michigan.
Concrete Vibrators, Electric and Hydraulic, Mechanical and Flexible Shaft Driven; Electric Power Units; Power Plants, Portable; Tie Tampers.

**Fairbanks, Morse & Co.** .......... 656
600 S. Michigan Ave., Chicago, Illinois.
Track Cars, Motor, Push, Hand, and Velocipede; Water Columns; Oil Columns; Tank Fixtures; Cattle Guards; Diesel Engines; Motors and Generators; Pumps; Scales; Windmills; Coaling Stations; Cinder and Ash Handling Equipment.

**Fairmont Railway Motors, Inc.** .......... 661
Fairmont, Minnesota.
Axles; Ballast Cleaners; Cars, Ballast Drainage, Electric Power, Extinguishers, Extra Gang, B & B, Inspection Motor, Push, Section Motor; Motor Car Engines; Mowers; Paint Spray Cars; Roller Axle Bearings; Trailers; Weed Burners; Wheels.

**Flexrock Company** .......... 749
2347 Manning Street, Philadelphia, Pennsylvania.
Concrete Resurfacer; Resurfacing Compound; Water-proofing Compounds; Dye for Wood or Concrete Floors; Floor Wax; Paint Cleaning Materials; Roofing Materials.

**General Electric Company** .......... 741
Schenectady, New York
Arc Welders; Motor-Generator Sets; Welding Generators.

**Holyoke Compressor and Air Tool Dept.** .......... 655
Holyoke, Massachusetts.
See Worthington Pump and Machinery Corporation.

**Homelite Corporation, The** .......... 749
2110 Riverdale Ave., Port Chester, New York.
Generators: Portable Gasoline-Engine-Driven; Pumps; Portable Gasoline-Engine-Driven.

**Industrial Brownhoist** .......... 740
Bay City, Michigan.
Buckets, Clamshell, Grab; Combination Crane Pile Drivers; Cranes, Crawler, Electric Gantry, Hand Traveling, Locomotive, Magnet, Pillar, Transfer, Tunnel, Wharf, Wrecking; Ditchers, Drainage; Draglines; Dumpers, Car; Hammers, Pile Driving, Steam; Pile Drivers; Tools, Wrecking.

**Ingersoll-Rand** .......... 649
11 Broadway, New York City.
Air Compressors; Air Hoists; Air Lift Pumping System; Centrifugal Pumps; Chipping Hammers; Compressors; Condensers; Hammers, Chipping, Calking, Riveting; Rock Drills; Hose; Pavement Breakers; Pneumatic Tools; Portable Grinders; Rail Bonding Outfits; Spike Drivers; Tie Tampers and Tie Tamper Compressors.

**Johns-Manville** .......... 739
22 East 40 Street, New York City
Asbestos-Cement Water Pipe, Electrical Conduit and Smoke Jacks; Corrugated and Flat Asbestos Sheets; Asbestos and Asphalt Roofing and Shingles; Insulating Board; Building Insulation; Boiler and Pipe Insulation; Packings; Refractory Cements; Asphalt Tile Flooring; Acoustical Treatment.

**Jordan Co., O. F.** .......... 745
East Chicago, Indiana.
Ballast Spreaders; Ballast Shapers; Bank Builders; Bank Slopers; Cars, Spreader; Ditchers; Ice Cutters; Snow Plows.

**Koppers Company** .......... 667-663
Pittsburgh, Pennsylvania.
Castings, Bronze and Iron; Coal; Coke; Creosote; Disinfectants; Insecticides; Bituminous Paving; Paints, Bituminous Base; Pressure Treated Poles, Posts, Ties, Treated Timber; Rings, Packing, Piston; Roofing; Tanks; Waterproofing; Weed Killers.

**Le Tourneau Inc.** .......... 746
Peoria, Illinois.
Carryall Scrapers; Angle Dozers; Bulldozers; Rooters; Power Control Units; Tractor Cranes; Pushdozers; Sheep's Foot Rollers.

**Lufkin Rule Co., The** .......... 749
Saginaw, Michigan.
Gages, Measuring; Rules; Scales, Steel Measuring; Tapes, Measuring; Micrometers; Tools, Machinists.

**Lundie Engineering Corporation, The** .......... 745
19 West 50th St., New York City.
Tie Plates; Rail and Flange Lubricators; Spring Rail Clips; Tongs.

**Maintenance Equipment Company** .......... 651
80 East Jackson Blvd., Chicago, Illinois.
Friction Car Stops; Rail and Flange Lubricators; Rail Layers, Hand and Power; Reversible Switch Point Protectors; Universal Portable Derails.

**Mall Tool Company** .......... 750
7746 So. Chicago Ave., Chicago, Illinois.
Bridge and Building Machines; Concrete Vibrators and Surfacers; Cross Slotters; Drills, Wood Boring; Flexible Shaft Grinders and Polishers; Gas and Electric Drills; Gasoline Engine, Air and Electric Chain and Circular Saws; Power Wrenches; Rail Grinders, Grinders for Signal Bond work.

**Mississippi Supply Company** .......... 674
Railway Exchange Bldg., Chicago, Illinois.
Switch Heaters.

**Morrison Railway Supply Corp.** .......... 733
1437-1439 Bailey Ave., Buffalo, New York.
Rail Welding; Steel Fabrication; Switch Point Guards; Welded Steel Pile Shoes; Wood Preservation.

**Moss Tie Company, T. J.** .......... 663
Security Building, St. Louis, Missouri.
Creosoted Black Gum Sectional Crossings; Creosoted Ties; Treated Lumber.

**Moto-Mower Co., The** .......... 748
1045 Washington Blvd., Chicago, Ill.
Sickle Bar Power Mowers.

**National Lock Washer Company, The** .......... 753
Newark, New Jersey.
Spring Washers.

**Nordberg Mfg. Co.** .......... 662
Milwaukee, Wisconsin.
Adzing Machines; Compressors; Crushers; Engines; Diesel and Steam; Mine Hoists; Power Jacks; Rail Drills; Rail Grinders; Screens; Spike Pullers; Track Shifter; Track Wrenches; Underground Shovels, Special Machinery.

**Oxweld Railroad Service Company, The**....646-647
230 No. Michigan Ave., Chicago, Illinois.
Acetylene Appliances; Acetylene, Dissolved; Joint Bar Reconditioning Equipment; Calcium Carbide; Carbide Lamps; Flame Cleaning Equipment; Floodlights; Frog and Crossing Reconditioning Equipment; Generators, Acetylene; Hard-Facing Materials; Oxygen; Oxy-Acetylene Cutting and Welding Equipment; Pressure Rail Butt-Welding Service; Rail Bonding Equipment; Rail End Hardening Equipment; Rail Reconditioning Equipment; Rail Welding Equipment; Switch Point Reconditioning Equipment; Blowpipes for Oxy-Acetylene Cutting, Welding and Heat Treating; Welding Rods and Supplies.

**P. & M. Co., The**....643
80 East Jackson Boulevard, Chicago, Illinois.
Bond Wire Protectors; Rail Anchors; Rail Anti-Creepers.

**Portland Cement Association**....650
33 W. Grand Ave., Chicago, Illinois.
Information on concrete track support; concrete piles and pile trestles; other uses of portland cement concrete.

**Q and C Co., The**....747
90 West St., New York City.
Anti-slip Rail Tongs; Car Replacers, Compromise Joints; Derails; Electric Snow Melters; Flangeway Brackets; Foot and Heel Guards; Gage Rods, Guard Rail Clamps; Insulated Rail Joints; One Piece Manganese Guard Rails; Rail Benders; Skid Shoes; Snow Flangers and Plows; Rail and Flange Lubricator; Switch Point Guards; Wheel Stops.

**Racine Tool and Machine Co.**....747
1738 State Street, Racine, Wisconsin.
Hack Saw Machines; Hydraulic Pumps; Metal Cutting Band Saws; Rail Cutters; Rail Saws; Valves, Hydraulic Balanced-Piston.

**Rail Joint Company, Inc., The**....653
50 Church Street, New York City.
Standard, Insulated and Compromise Joints; Fibre Insulation.

**Railroad Accessories Corporation**....672
137 East 42nd Street, New York City.
Drills, Rail; Power Bolting Machine; Power Track Machine; Screw Spiking Machine; Tie Boring Machine.

**Rails Company, The**....754
New Haven, Connecticut.
Compression Rail Fastenings; Compression Screw Spikes; Electric, Gas and Oil Snow Melters; Flange and Curve Rail Lubricators; Foot and Heel Switch Guards; Full Throated Cut Spikes; Interlocking Flangeway Brackets; M & L Track Construction; Snow Flangers and Plows; Switch Point Guard Rail; Wheel Stops and Skid Shoes; Spring Spike; Automatic Safety Switch Lock; Strip weld process-Rebuilding battered rail ends.

**Railway Maintenance Corporation**....669
Pittsburgh, Pennsylvania.
Banding, Tie & Timbers; Moles, Ballast Cleaning; Rail Joint Lubricators; Track Derrick, Demountable.

**Railway Track-work Co.**....748
3132-48 East Thompson Street, Philadelphia, Pennsylvania.
Abrasives; Cross Grinders; Rail Grinders; Rail Drills; Rail Grinding Wheels and Blocks; Track Grinders.

**Ramapo Ajax Division**....658
230 Park Avenue, New York City.
Crossings; Frogs; Guard Rails; Guard Rail Clamps; Manganese Track Work; Rail Braces; Rail Expanders; Rail Lubricators; Switches; Switchstands and Fixtures.

**Reliance Spring Washer Division**....644
Massillon, Ohio.
See Eaton Manufacturing Company.

**Richmond Screw Anchor Company, Inc.**....746
816 Liberty Avenue, Brooklyn, N. Y.
Screw Anchors.

**Simmons-Boardman Publishing Corp.**....664-750
105 West Adams Street, Chicago, Illinois.
Books; Cyclopedias; Publications.

**Skilsaw, Inc.**....743
5053 Elston Avenue, Chicago, Illinois.
Portable Electric Drills; Portable Electric Hand Saws.

**Sperry Rail Service**....738
1505 Willow Avenue, Hoboken, N. J.
Detector Car Testing Rails in Track; Electric Flash Butt Welding of Rails.

**Stanley Electric Tool Division, The Stanley Works**....744
New Britain, Connecticut.
Electric Portable Drills, Bench Grinders, Hammers, Sanders, Saws and Metal Cutting Shears.

**Tar and Chemical Division**....667
Pittsburgh, Pennsylvania.
See Koppers Company.

**Teleweld, Inc.**....654
Railway Exchange Building, Chicago, Illinois.
Frog and Switch Reclamation; Joint Bar Shims; Rail Slotting Equipment; Rail Heat Treating; Rail Welding.

**Templeton, Kenly & Co.**....749
1020 So. Central Ave., Chicago, Illinois.
Jacks, Track; Rail Puller & Expanders, Tie Spacers.

**Tennessee Coal, Iron & Railroad Company**....735
Birmingham, Alabama.
See U. S. Steel Corporation Subsidiaries.

**Timber Engineering Company, Inc.**....665
1337 Connecticut Avenue, Washington, D. C.
Claw Plates; Clamping Plates; Grids; Split Rings; Timber Joint Connectors; Toothed Rings; Termite Shields.

**Timken Roller Bearing Company, The**....652
Canton, Ohio.
Bearings, Journal Box, Locomotive, Passenger Car, Section Car, Tapered Roller, Thrust; Steel, Alloy, Electric Furnaces, Open Hearth, Special Analysis; Tubes, Seamless Steel, Super-Heater.

**Union Carbide and Carbon Corporation**....646-647
30 East 42nd Street, New York City.
See Oxweld Railroad Service Co.

**Union Metal Manufacturing Co., The**....742
Canton, Ohio.
Pile Tubing; Steel Casings.

**U. S. Steel Corporation Subsidiaries**....735
Alloy Steel; Bars; Bolts; Cement; Fencing; Fence Posts; GEO Track Construction; Guard Rails; Joint Fastenings; Nuts; Rail Joints; Rails; Screw Spikes; Sheet Piling; Steel Alloy; Steel Plates and Shapes; Structural Steel; Tee Rails; Tie Plates; Ties, Tubing; Wire and Wire Products.

**Warren Tool Corporation**....666
Warren, Ohio.
Adzes, Claw Bars, Lining and Tamping Bars, Flatters, Rail Forks, Rail Tongs, Sledges and Hammers; Spike Mauls, Spike Pullers, Clay and Tamping Picks, Tie Plug Punches, Tie Tongs, Track Chisels, Track Punches, Wrenches.

**Wheeler Lumber Bridge & Supply Co.**....742
Des Moines, Iowa.
Laminated Culverts; Laminated Railroad Crossings.

**Williams & Co., J. H.**....744
225 Lafayette St., New York City.
Drop-Forged Wrenches (Carbon and Alloy), Detachable Socket Wrenches, Reversible Ratchet Wrenches, Tool Holders, "C" Clamps, Lathe Dogs, Eye Bolts, Hoist Hooks, Thumb Nuts and Screws, Chain Pipe Tongs and Vises, etc.

**Wood Preserving Division**....668
Pittsburgh, Pennsylvania.
See Koppers Company.

**Woodings Forge & Tool Co.**....657
Verona, Pennsylvania.
See Woodings-Verona Tool Works.

**Woodings-Verona Tool Works**....657
Verona, Pennsylvania.
Rail Anchors; Special Alloy and Carbon Nut Locks; Track Tools; Fixed Tension Spring.

**Woolery Machine Company**....737
29th & Como Ave., S. E., Minneapolis, Minnesota.
Bolt Tighteners; Motor Cars; Railway Weed Burners; Switch Heaters; Tie Cutters.

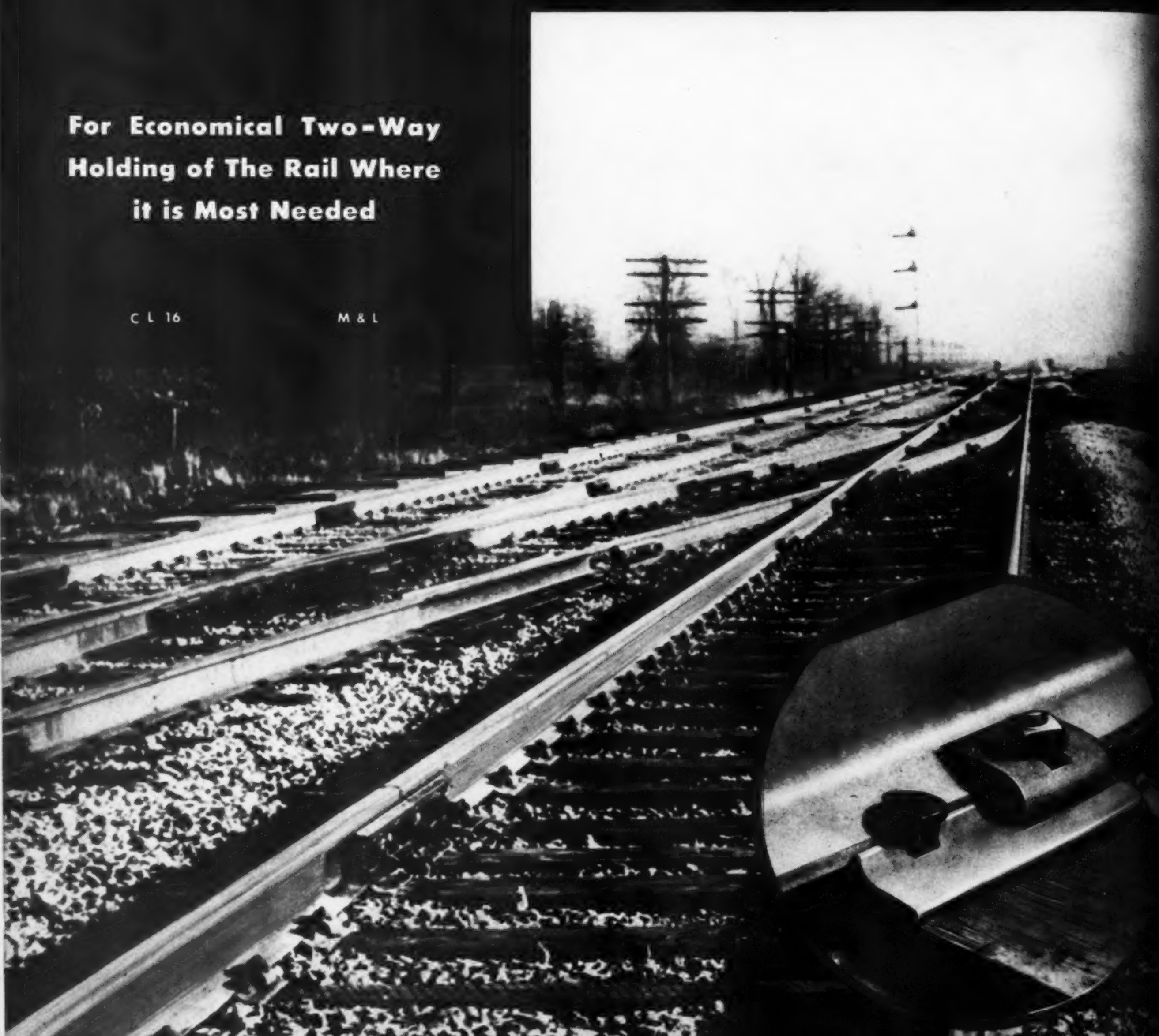
**Worthington Pump and Machinery Corporation**....655
Harrison, N. J.
Compressors, Portable and Semi-Portable; Air Tools; Rock Drills; Rail Cars.


IMPROVED HIPOWERS
IMPROVE TRACK
THE NATIONAL LOCK WASHER COMPANY, NEWARK, N. J., U. S. A.
A COMPLETE LINE OF RAILWAY SPRING WASHERS

# Compression Track Fastenings

**For Economical Two-Way Holding of The Rail Where it is Most Needed**

C L 16 M & L



## THE RAILS COMPANY

WASHINGTON, D. C. — CHICAGO

General Office
178 GOFFE STREET
NEW HAVEN, CONN.

NEW YORK CITY — ST. LOUIS